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WORLD CROPS

Editor: Sir Harold A. Tempany, C.M.G., C.B.E., D.SC., F.R.I.C.

Vol. 6. No. 10 OCTOBER 1954

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Published monthly by Leonard Hill Limited, Stratford House, 9 Eden Street, London, N.W.1, England (Tel. Euston 5911)

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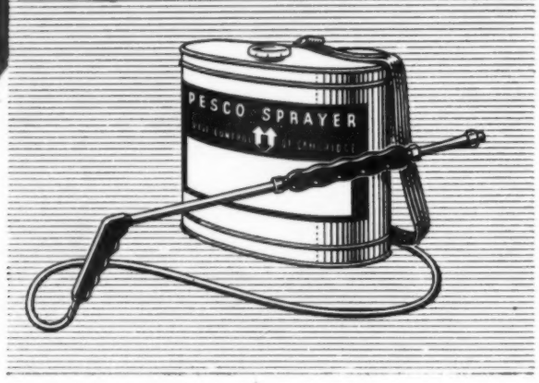

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Editorial Comment

World food production

THE appearance of the report on the state of food and agriculture for 1954 by FAO has been much publicised, especially in view of the fact stressed in the report that for the second season in succession world food production has continued to rise faster than the increase in world population.

Although the achievement of this position in place of the former discouraging situation is a matter for tempered satisfaction, there is no ground for complacency or for a feeling that, in view of the altered outlook, the future can safely be left to look after itself. As the authorities of FAO have themselves pointed out, the position must be viewed against a background of surpluses of a number of commodities in certain regions and serious shortages of the same commodities in others, leading to widespread malnutrition.

Of the problems remaining to be solved, those of reducing existing surpluses without unbalancing trade and of ensuring the improvement of nutrition and food supplies evenly throughout the world stand out as claiming urgent attention. The surpluses referred to exist mainly in North America and are chiefly concerned with grain; on the other hand, the rises in agricultural production which have occasioned the present improved position have occurred in Western Europe, the Near East, the Far East and Oceania. Moreover, although some products, such as wheat and sugar, are in surplus supply in a number of exporting countries, other countries which previously were large importers of them are now endeavouring to solve their problems by expanding their own production and so economising imports, even although it may be quite uneconomic to do so.

It seems, therefore, that any solution of the present world problems of supply as between the countries of surplus and deficiency must depend on finding a satisfactory solution to the problem of exchange. If this cannot be achieved, there seems no escape from the piling up in certain countries of surpluses of commodities which are badly wanted in others which do not possess the exchange needed to pay for them.

In any event, there is no escaping the fact that sooner or later the limiting value to the equation between population increase and increased world food production must be reached. The only possible solution then will be the regulation of population increase in harmony with the ability of the world to produce food to support it. It may be sooner or, more probably, later, as novel and unexpected methods of food production become developed; of this, the production of food by culturing algae as described in an article on another page is a case in point.

Mechanisation in the tropics

THE possibilities of mechanisation of agricultural operations in tropical countries are yearly attracting increasing attention. Recently, the Secretary of State for the Colonies set up a Colonial Agricultural Machinery Advisory Committee with a salaried technical secretary and made available funds from colonial development and welfare resources to finance the appointment.

At a conference of Colonial Directors of Agriculture held at Wye College last September this officer, Mr. J. C. Mayne, read a paper on the subject of mechanisation of agriculture in the Colonies and summarised some of the present needs. Chief among these is the need for officially co-ordinated provision for testing and reporting on machinery for use in colonial agriculture and for a definite information service on the subject. This is at present partly met by the agricultural advisory services of the Colonial Office, while it has been suggested that a Commonwealth Bureau of Agricultural Engineering should be set up in connection with the National Institute of Agricultural Engineering at Silsoe.

The latter proposal is believed to be under active consideration, but in the meantime an active step towards the achievement of part of these aims in West Africa comes from the Gold Coast, where it has recently been decided to establish in connection with the Faculty of Agriculture of the University College of the Gold Coast, a machinery testing service to assist in the development of equipment needed for the expansion of mechanised agriculture in the tropics in general and West Africa in particular. The service is intended both for production machines new to West Africa and for prototypes which require testing and further development 'in the field' with all that this entails. In such development tests close liaison with the manufacturer is essential and some may wish to send technicians to work with the machines. The Faculty of Agriculture will provide accommodation and facilities for such technicians at the college research station.

Tests of production machines will be carried out either at the research station or, in co-operation with the Gold Coast Department of Agriculture, at one of the agricultural stations.

At the outset the testing service will be restricted to machinery and equipment required for the programme of research recently drawn up by a technical committee for agricultural mechanisation in the Gold Coast.

The authorities of the Gold Coast University College are to be congratulated upon the enterprise shown in sponsoring this new development, which may well have an important bearing on agricultural development not only in the Gold Coast, but also throughout West Africa, and indeed over a very much wider field.

Our best wishes go to the new enterprise, the activities of which will be followed with interest. It may well prove the forerunner of similar enterprises in other parts of the tropics, for which indeed abundant scope exists, for it has always been an article of faith with ourselves that the problems of mechanisation under tropical conditions can only be solved by trials and experiments in design carried out under actual tropical conditions.

It would accordingly seem that, if these developments materialise and are associated with the establishment of a Commonwealth Bureau of Agricultural Engineering and the operation of a Colonial Agricultural Machinery Committee, the way will have been paved for the expansion of mechanisation in the British tropical dependencies.

Rural land losses

THE recent lecture by Dr. G. P. Wibberley before the British Royal Society of Arts on the above subject raised many aspects of a question which of late years has assumed ever-increasing urgency. As Prof. Dudley Stamp, who acted as chairman, put it, in Great Britain there are 50 million people trying to live on 56 million acres and the ever-present problem is the allocation of the land between competing users.

In his lecture, Dr. Wibberley pointed out that as it is practised in Great Britain today physical land planning has two major weaknesses, *viz.* lack of knowledge of how land uses are changing and lack of adequate bases on which the claims of rival uses may be compared. He considered that a useful concept might be the ' replacement value ' of land lost to urban growth, by which is apparently intended the cost of replacing agricultural land lost to urban extension by upgrading poor upland areas, mining land and poor quality lands in the lowlands, etc. The need is to construct yard-sticks which can be used to sort out the economic merits of land use arguments in the future.

With this one may agree, but in over-populated Britain we are facing a problem which will assume world proportions in the distant but foreseeable future. It is obvious that with increasing populations the world over the ultimate task of their maintenance is conditioned by ability to make available the products of other parts of the world to those regions incapable of producing all they need from the land available to them. Within the memory of living people Great Britain was to all intents self-supporting in food. The growth of population and the ability to import the food they need is due to industrialisation, expansion of exports and development of agricultural production in countries overseas.

To enable the world population to attain the maximum expansion which is possible, the same problems which confront Britain must be faced and solved on a vastly larger scale, plus a number of others, such as the elimination of war and the devising of a system of exchange which is free from the difficulties and tangles which confront the world at present.

Advice on 'change

FOR the past four years N.A.A.S. advisory officers of the East Midland Province have been ' on the stand ' at the weekly market of the Lincoln Corn Exchange. Amongst the 150 or so trade stands is the N.A.A.S. advisory stand, a small table 2½ by 3½ ft. Different exhibits or demonstrations have been presented each week and both farmers and merchants have readily welcomed this educational invasion of a primarily commercial function. So far as possible the exhibits are ' live ' or topical, and it has been found that a technical point can be put over much more forcibly in this way than by a week's writing. No less important is the fact that farmers and merchants know that they can bring their queries with them to the Corn Exchange on market day and discuss them there personally and informally with N.A.A.S. representatives. A third virtue in this novel method of approach is that the stand can be used as a ' shop window ' for advisory literature.

One of the difficulties that has had to be faced and overcome is to avoid showing proprietary products in the exhibits. This cannot always be achieved simply by removing labels or other identifying attachments—sometimes the colour or shape of a product makes it typically recognisable. This, of course, is one of the hardy problems of official advisory work, but it has particularly invidious potentialities in the midst of a market devoted to buying and selling. That it has been safely overcome is shown by the fact that farmers frequently consult the N.A.A.S. representatives on the stand about seed varieties or other products they are contemplating purchasing and the unbiassed opinions given are respected by farmers and merchants alike.

A brief account of the progress of this weekly venture has been given in the *N.A.A.S. Quarterly Review* (**24**, 182, 1954), and it might well be studied by all who are engaged upon agricultural advisory duties. Personal contact is still the surest method of getting things done—no other means of communication can build as much confidence or do it as quickly. Also, taking advisory services to the farmers is far better than waiting for farmers' requests. The Lincoln experiment deserves widespread imitation.

The state and agriculture

THE recent delivery of the first Middleton memorial lecture before the Agricultural Education Association of Great Britain by Sir James Scott Watson not only serves to remind us of the great services rendered to agriculture by the late Sir Thomas Middleton, but also of the fact that Middleton himself was one of the select band of pioneers who succeeded in establishing the place of agriculture in the policies of Government and helped to formulate the lines which agricultural development and government policies in relation thereto should follow.

If one contrasts the official attitude towards agriculture when Middleton first started his career as a scientific agriculturist in 1880 with the position which it occupies today, not only in Britain, but in countries the world over, the picture one gets is startling and dramatic. In those days agriculture was regarded as an art, while its practitioners were conceived as artists: artists working in a very mundane medium no doubt, but none the less artists. The idea of agriculture being underlain by scientific principles was as novel as it was repugnant to the official mind, nurtured as this was in the concept that education based upon classical Greek and Latin was the best and, in fact, the only possible training for the administrator. Science was largely anathema, as shown by the habit of those trained in the older educational disciplines of referring to science as ' stinks ' and scientists as ' stinksmen.'

By contrast, ' Middleton,' to quote Sir James Scott Watson, ' saw farming for what it is—at once a technology based on science, a craft based on tradition, a business founded on economics and not least a way of life.'

Projected in middle life into the arena of officialdom after a career as a teacher of agriculture and a pioneer of agricultural research in a number of academic centres, commencing, surprisingly enough, with an appointment in the small Indian State of Baroda, Middleton filled a number of

posts in connection with the Ministry of Agriculture, the Development Commission, and later as chairman of the Agricultural Research Council, a post which he held until his death in 1943. He also played an important part in helping to extend food production in Britain during the first world war. He was a member of the Linlithgow Royal Commission on Agriculture in India, which so powerfully influenced agricultural development in India itself and in many other parts of the tropical world.

It can truly be said that, in concert with a number of others such as the late Sir Daniel Hall, Somerville, Sir Rowland Biffen, T. B. Wood and others, he played a leading part in establishing the recognition of the part science should play in regard to agricultural development, which has borne, and is bearing, such abundant fruit in the shape of schemes for agricultural research and improvement, and the loosening of the Government purse strings, without which such developments could not be achieved.

Human wastes and crops

MODERN civilisation is often criticised for returning to the soil so much less of its wastes than more ancient civilisations. Because this is a subject upon which widely varied opinions have been expressed, a recently published report upon it by the Natural Resources (Technical) Committee, is of more than ordinary interest (' The Use of Towns' Wastes in Agriculture,' 1954, H.M.S.O., 1s. 3d.). The conclusions the committee has reached, after a thorough survey of the facts and the means of recovery at present available, shatters the views of the optimists.

The *maximum* recovery of sewage and refuse for return to the soil would not displace more than 10% to 15% of Britain's present annual usage of fertilisers. The opinion that fertilisers are used because human wastes are discarded is shown to be wildly exaggerated. Nor would their humus contribution be particularly significant. Full recovery of these wastes would certainly add 750,000 tons of dry organic matter to British farm soils and at first sight this seems a large figure. It must be judged against the background of the present annual input of organic matter by other means, *e.g.* manure, straw, ploughing-in crop residues, etc., This amounts to 15,700,000 tons of dry organic matter each year. Thus the costly and cumbersome task of recovering and distributing urban wastes would add only about 5% to the present supply of humus-making material for British agriculture. To do so much to obtain so little would hardly be economic; nor in the committee's view is there any need to do so, for their examination of all available evidence has found no support for the view that British soil fertility has declined in the past 50 years.

No criticism of existing schemes by which sewage wastes are made available as manures is expressed; where such schemes can be economically conducted they are clearly useful. But processes for jointly composting liquid sewage sludge and town refuse are forthrightly dismissed—' there is no case for authorising the expenditure of public money on pilot plant experiments.' Any practical method for recovering the nitrogen in sewage effluent would be well worth investigation, but, in view of the fact that the dilution is such that the nitrogen content is only about 40 parts per million, it is difficult to foresee any process that could hope to be economic.

There are many enthusiasts for sewage and refuse recovery and they are unlikely to find these brief comments acceptable. They must be urged to study the report in its full and factual detail; the committee's conclusions, negative though they may be in the main, will be convincing enough to all reasonably open-minded people.

Milk v. virus diseases?

IT is unusual today for a newly discovered pesticide to be non-toxic; for it to be a well-known nutritious article is unusual to the extent of joining the ' believe-it-or-not ' class. At the John Innes Horticultural Institution it has been found that *milk* is outstandingly effective as a spray to prevent glasshouse tomato plants from becoming infected with mosaic disease. In recent years, well over 90% of the plants in the John Innes houses have been infected with this costly virus disease; spraying with a 10% milk solution at 10-day intervals during the 1954 season has brought the infection rate down to 5%. Why milk should be successful in a field where hitherto no other substance has seemed even promising is still unexplained. The *modus operandi* of the discovery has been empirical, not deductive. F. C. Bawden, of Rothamsted, had noted that the transmission of this disease by glasshouse workers was reduced if they kept their hands and implements moist with milk or whey; research workers at the John Innes Institution decided to investigate the potentialities of milk as a direct plant spray.

Several interesting possibilities are raised. Will it be found that it is a single constituent of milk's complexity that provides the anti-virus effect? If so, a more concentrated spray base than milk itself may be preparable as a dairy industry by-product. Or will growers find it cheaper and easier to buy ' raw milk '? Also, can milk reduce the spread of other plant virus diseases? All of these diseases are virtually unconquered and most of them steadily increasing. In comparison with many active ingredients of plant sprays today, milk is not expensive; technical success with outdoor crops' virus troubles could be converted into economic success as well. Is it the protein content of milk that exercises the protective influence? Plant virus diseases are often regarded as protein breakdown disorders and it may be the milk protein deposited on the foliage that diverts or repairs the protein-damaging effects of the disease. If so, other protein sprays might also be effective.

Farm labour in New Zealand

CONTRARY to widespread popular belief, the demand in New Zealand for immigrant farm workers is not great. This is stressed in a recent article in the New Zealand Labour and Employment Gazette, which states that the oft-repeated assertion that the Government should bring in unlimited numbers of female domestics and male farm workers is not borne out by the facts. Indeed, the difference between the maximum number which could be brought in

theoretically in these categories and the numbers actually arriving is not very great.

Supporting this are a number of significant changes which have occurred in New Zealand's agricultural industry between 1936 and 1951. Though the area of land under production increased by 608,000 acres, the number of persons engaged in agricultural and pastoral pursuits decreased by roughly 35,000 men and women. In the same period, the number of agricultural tractors increased by over 34,000 (exclusive of 3,812 rotary hoes and garden tractors). The number of milking machines increased by over 11,000 and the number of electric motors on farms by over 81,000. These increases in mechanised equipment were spread over the farming industry as a whole and undoubtedly displaced a number of farm workers.

During the post-war period up to January 31, 1954 some 899 British, 350 Dutch and 203 displaced persons were taken into the country as farm workers under the free and assisted passage schemes and have been absorbed without exhausting the vacancies. The latter, however, represent no more than a few hundred farm workers a year.

The area of new farm land in New Zealand which could be brought into economic production is limited and even 500 new farms a year would provide regular work for no more than 800 to 1,000 workers. Furthermore, no promise could be given that farms of their own would ultimately be available for the immigrants—a fact which already seems to be affecting the flow of Dutch contract farm workers to New Zealand.

Mechanisation of land clearing

THE August and the September numbers and the present number of WORLD CROPS contain articles and correspondence dealing with the mechanical clearing of land. In regard to the mechanisation of such operations under tropical conditions, while fairly full information is now available concerning operations under conditions of moderate rainfall, there is but little published data concerning the clearing of land mechanically under conditions in the wet tropic.

It is accordingly of interest to record that the July issue of the *Planters' Bulletin* of the Rubber Research Institute of Malaya contains an article by the manager of a rubber estate in the Malayan Federation on his experience with attempts at mechanical clearing of an area of old abandoned rubber using two Caterpillar tractors—one D4 and one D8— for the work. The area is described as having reverted to secondary jungle, while the lie of the land was undulating. The technique adopted was that of using the bulldozer blade to push the trees over, stacking the trees in windrows after felling, burning the stacks, ploughing the land with a Fordson Major diesel tractor, terracing with the D4 tractor and holing for planting with a Ferguson post hole digger and a Ferguson tractor. The cost of these operations was stated to have been approximately $170 (Straits) per acre, equivalent to 396s per acre, which includes all costs up to the conclusion of replanting, except manuring and planting cover crops. Compared with this, more or less parallel work in Tanganyika scrub land has been stated to have cost up to 350s. per acre, at which rate it was judged uneconomic. Of course, the two cases are not strictly comparable, since wage rates are not the same, while conditions are very different; nevertheless, it is not without interest.

Commenting on the matter, the editor of the *Planters' Bulletin* remarks on the many snags which have revealed themselves in relation to mechanical clearing in Malaya, notably the incidence of breakages and the consequent necessity of carrying large stocks of spares for tractors and the necessity for having spare power units standing by, all of which build up costs. The cheapness of tree poisoning, which is the method most commonly used in Malaya in dealing with old stands of rubber, has also been a factor detracting from mechanical clearing.

We have repeatedly called attention to the practice of ball clearing as developed in the American tropics for this type of work and it seems worth while considering whether it could find economic application under wet tropical conditions. A possible drawback, however, seems to be the high cost of the equipment and its weight, which makes the cost of transporting it from place to place very high, a point brought out in correspondence in this issue.

A new virus disease of citrus trees

AN article in WORLD CROPS of February 1952, p. 64, by Dr. A. F. Posnette described the disease known as citrus decline or tristeza, which in Africa, South America and California has been a prolific source of loss, causing the death of many hundreds of thousands of citrus trees. The disease is due to a virus and the most successful method of combating it is to grow the trees on stocks which are resistant to the virus rough, lemon stocks possessing marked powers of resistance. It appears from a recent issue of the FAO *Plant Protection Bulletin* that the trifoliate orange, *Poncirus trifoliata*, has advantages in this regard, for, in addition to having marked resistance to tristeza, it is markedly tolerant of cold and is resistant to citrus nematodes (*Tylenchus semipenetrans*), foot rot and water damage.

Unfortunately, despite these desirable characters, this species suffers from the defect that it is apparently susceptible to yet another virus disease termed exocortus or ' scaly butt,' which causes scaling of the butts and stunting of the tops of citrus trees attacked by it. The disease has been reported from citrus-growing areas throughout the world, including California, Louisiana, Argentina, Uruguay, Australia and South Africa. It was apparently first recorded on trifoliate butts in Florida in 1952, but since then has been recorded on trifoliate root stocks budded with sweet oranges, navel oranges and grapefruit. It seems that the causal agent of the malady may be a bud-transmissible virus which has been present in Florida for some time.

The choice of root stocks tolerant of tristeza virus and of heavy, wet soils is very limited and in areas where these conditions prevail *Poncirus trifoliata*, possessing both these desirable qualities, has been hailed with enthusiasm, but experience in Florida indicates that trifoliate stocks should be used with great caution, at least until more is known about the incidence and occurrence of the exocortis disease in different citrus varieties.

Cardamoms in South Western India

W. WILSON MAYNE, B.Sc.

Cardamoms are a spice crop cultivated on some scale in Southern India; there is little published literature concerning the crop and the following account of the industry is of interest.

WHILE the Malabar coast of Western India has perhaps been somewhat overshadowed by the romantic glamour of Ceylon and the islands of the East Indies as sources of the spices which played such a major part in the commercial exploration of the Indian Ocean, yet it has a history in the spice trade probably older than either. Pepper was exported from Malabar to Alexandria as early as the 1st century A.D. and trade around the shores of the Arabian Sea and overland to the Mediterranean civilisation probably included spices for centuries before that. Pepper still remains an important Malabar export along with several other spices, coconut products and the more recent products, tea, coffee, cashew nuts and rubber.

Among the spices of Malabar, cardamoms play an important part and the conditions of their production are of considerable agricultural interest. The Western Ghauts of Southern India produce practically the whole of this crop which reaches world's markets, affording a somewhat unusual instance of the major commercial production of a tropical crop taking place within its natural habitat. Furthermore, the conditions of production range over the whole gamut of tropical agricultural systems and provide an illustration of the satisfactory utilisation of one of the most difficult vegetation zones—the wet monsoon forests.

The cardamom plant

The cardamoms of commerce are the seed capsules of *Elettaria cardamomi*, a member of the Zingiberaceae, somewhat similar in habit of growth to ginger. The plant consists of a branching rhizome running in the superficial soil layers, from which arise pseudostems consisting of sheathing leaf bases, each expanding into a lanceolate leaf blade some 3 ft. in length. The leafy pseudostems may reach 10 to 15 ft. in height in the larger varieties. Flowering panicles arise from the bulbous bases of the pseudostems and develop either vertically or horizontally, according to the variety. These may be 2 or 3 ft. in length and each consists of a main rachis with short alternate peduncles bearing some half a dozen short, closely-set, alternating and secund pedicels. The flowers borne on these pedicels are about an inch across with three white spreading corolla lobes delicately veined with violet. The inferior capsule varies considerably in shape from subglobose to fusiform and is three-celled, each cell containing five to seven small black, rugose, angular seeds. The seeds are the actual commercially used product, but most cardamoms reach the marketing centres in the dried capsules—a system of marketing which helps to preserve the essential oil in the seed and to discourage adulteration.

Distribution and habitat

The cardamom occurs throughout the monsoon forests of South India from South Travancore to North Mysore at elevations between about 2,500 ft. and 4,500 ft. in the Western Ghauts. In many parts of these forests it is a characteristic element in the succession which develops when a large tree dies and lets in the light to the forest floor. In such sites it grows and flourishes until the canopy closes in again.

The climatic conditions in its range are characterised by a heavy annual rainfall varying between 100 and 300 in., mainly concentrated in the months June to September, when the south-western monsoon blows, but there is usually adequate rainfall from April to November. The dry season varies in length from not more than about three months in the south to some five months in the north. The length of this dry season appears to be the main factor in determining the natural range of the species. In the more southern regions the plant occurs in areas of lower annual rainfall and somewhat lighter forest than in the north. Thus the Cardamom Hills of Central and North Travancore in latitude 10° to 11°N experience a rainfall hardly exceeding 120 in., whereas in Mysore and Coorg, some 250 miles to the north, the wild cardamom is restricted to the heaviest forests near the westerly edge of the hills with 200 to 350 in. of rain.

Although the plant develops with lightening of shade by the death of forest trees, it cannot stand continuous exposure and its light requirements cover a rather narrow range of intensity. It must be regarded, therefore, as a relatively ephemeral species developing in one site to reproduction and then being squeezed out by the developing shade canopy, to spring up again in another as forest veterans crash down into decay.

Commercial exploitation

The earliest detailed account of the cultivation of cardamoms to reach the West is contained in Buchanan-Hamilton's description of his journeys through the west

General view of a cardamom plantation

coast of India published in 1807. This account is based on a system he saw in North Kanara and, although it still exists in that area, its importance is negligible both with respect to area and to production. Even at that time it could have only accounted for a small portion of the quantities entering commerce, but the balance then was collected as minor forest produce and fell outside the sphere of agriculture. The most that could be said was that the collectors of cardamoms probably assisted nature by the selective felling of trees to produce the desirable ecological conditions for cardamom development. In Coorg, such a refinement of jungle collection developed into a more or less regular system in the 19th century and this system—' the malai ' —is still the principal type of cardamom production in that province.

As a plantation crop, cardamoms came into some prominence as a secondary crop in the wetter and more heavily shaded parts of coffee estates in Mysore, quite early in the history of East Indian coffee, but the major development occurred at the end of the 19th century, when the Travancore Government gave up its monopoly over the cardamom trade and permitted producers to sell their own produce where they pleased. From that time the industry took on its modern aspect.

The modern cardamom industry

The area under cardamoms in South India is now somewhere in the region of 100,000 acres scattered through the hill forest zone of the Western Ghauts. Some 60% of the area lies in Travancore and Mysore follows next in importance. There are substantial areas also in Madras and Coorg and a smaller area in the extreme south of Bombay. Statistics of production are even less reliable than those of area and any figure can be little more than an informed guess, since considerable quantities pass into internal trade through small local markets. However, a figure of some 2,000 tons annually is probably a not unreasonable estimate of production, of which perhaps 30% are exported.

It is characteristic of what are commonly called plantation crops in Southern India that they have developed in holdings of a wide variety of size and organisation, and cardamoms are no exception. There are estates of 200 to 1,000 acres organised on lines similar to coffee, tea and rubber plantations, with resident labour forces and skilled managements. At the other end of the scale are smallholdings of a few acres employing casual labour seasonally for weeding and harvesting. In many coffee estates in Mysore cardamoms are grown as a secondary crop in ravines and other sites too moist for the main crop. In North Kanara they form an element in garden cultivation under the shade of areca palms and aided by irrigation, while in Coorg the ' malai ' system represents but one step from primitive jungle collection.

The North Kanara system

Although this mode of cardamom production is of very minor importance, it is of interest as a highly developed horticultural system. Rising steeply from a narrow coastal plain, the uplands of North Kanara form a broken plateau of broad paddy-filled valleys and low laterite hills clothed with small jungle or poor grass. The paddy is irrigated from the heads of the valleys and where the streams debouch into the broad terraced paddy lands there are the homesteads each with the little garden area of areca palms. Under the palms are the cardamoms, possibly patches of vegetables and perhaps some flowering shrubs. Similar gardens, dominated by palms—areca nut or coconut—are common both in the hills of Mysore and Coorg and in the plains and foothills of Malabar, Cochin and Travancore, but only in North Kanara is the under-storey crop provided by cardamoms.

This production of cardamoms is dependent on irrigation, as the dry season is very long and often exceeds six months in duration. The system has declined considerably in the past 20 years or so and it is doubtful whether there are more than a thousand acres all told. The decline has been associated with a very severe virus disease—mosaic or ' marble disease,' which would have undoubtedly eliminated production altogether if it had been any more than a very subsidiary cash crop. As it is, custom would appear to have ensured survival when strict economics would have killed it. Recently the adoption of vigorous sanitary measures has given new hope to the cardamom grower and with recent high values may revive this form of production to some degree.

The cardamom plant in a plantation

The Coorg Malai system

The system of production in the heavy evergreen forests of Coorg takes us back to the very origins of agriculture. The cardamom is indigenous to these forests and the ' malai ' is simply a more or less standardised method of creating the most suitable natural environment for the spontaneous appearance of the crop, with the additional insurance of the provision of plants to supplement the natural seeding. It is, of course, a simple step, now the general rule, to plant the site prepared at regular spacing.

In an area of jungle, small sites usually less than half an acre in area and longer than they are broad, with the longer axis running roughly north and south, are felled in the dry season. Each strip is separated from another by at least half a chain, and usually more, of unfelled forest. As a rule, only a few large trees are felled and there is a strong belief that the heavier the fall the better for the subsequent development of wild cardamom seedlings. The felled area is weeded once a year; harvests commence about the third year and continue annually for seven or eight years, when the land is allowed to go back to jungle. The size of the plots is such that regeneration is reasonably rapid and, like all methods of shifting cultivation, the system is not seriously destructive provided the pressure on the total area of forest is light.

On the other hand, yields are small and much subject to the depredations of rats and miscellaneous insects. For considerable periods in the south-western monsoon the plots are completely left to themselves and may be damaged by monkeys and elephants, as well as by the smaller fauna. Harvesting takes place from September to January, but, since ripening of the fruit commences as early as July, much crop is lost.

It is curious that, although there are similar forest areas in Mysore to the north and in Malabar, Cochin and Travancore to the south, this mode of cardamom production is restricted to Coorg. The actual area under ' malai ' cultivation is difficult to estimate, but there are some 40,000 acres

Base of cardamom clump showing last season's flowering shoot with one or two capsules (*left*) **and new season's developing inflorescences** (*front left centre*)

of forest let out for this type of utilisation and perhaps one-tenth is actually under cardamoms at any given time.

The plantation system

At present by far the greater acreage of cardamoms consists of plantations and smallholdings employing generally similar cultural methods. For the most part they lie in the section of the Western Ghauts south of the Nilgiris and the Palghaut gap, with the main concentration in the Cardamom Hills of Travancore. There is, of course, a good deal of variation in the efficiency of management and, while the larger units are usually the soundest agriculturally, this is not always the case and many smallholdings are well run.

The fundamental basis of the system is the selection of suitable jungle, the removal of the undergrowth, and the thinning of the overhead canopy to create an environment in which cardamoms can be planted and cropped at an economic level of productivity.

Planting material is obtained either by splitting up established clumps or by growing seedlings in specially prepared nurseries. The former method has the advantages of simplicity and earlier cropping, but is open to objection in that it has been shown to facilitate the spread of virus disease and may lead to the development of monoclonal patches, which, since cardamoms are self-sterile, could interfere with fruit setting. The nursery production of seedlings is therefore more satisfactory and is now the usual practice on the larger estates, but it demands careful management, since in the early stages seedlings are delicate and very liable to " damp off."

Field planting, whether of seedlings or rhizome cuttings, is normally made in shallow pits some 6 to 8 ft. apart.

Cardamom estate management

Obviously, the management of the shade canopy is the primary operation and presents a nice problem in applied ecology, approached in practice on entirely empirical lines. It involves the removal of trees unfavourable to cardamoms, the sparing of seedlings of suitable species as future elements in the canopy and, in some cases, the planting of shade trees where natural regeneration is inadequate. The special peculiarity of the cardamom is that it normally constitutes a major element in an early stage of a comparatively rapid succession back to the forest climax and the efforts of the cardamom planter are directed to stabilising this stage for as long as possible. The degree of success varies, but it is rare for a planting to remain at an economic level of productivity for more than 15 to 20 years.

In addition to shade management, other cultural treatments have until recently rarely involved more than weeding and sometimes the removal of older leafy shoots, although the necessity for the latter treatment is not universally accepted. In recent times there have been some developments in the direction of disease and pest control, and there is evidence that mulching with vegetable debris can be helpful in maintaining productivity.

Diseases and pests

A virus disease and an insect pest have played a major part in the recent history of the industry. Of these two, the latter—a species of thrips—has had the most spectacular history. It appeared first in 1934 in the Anamalli Hills in Madras Province and by 1940 had affected all cardamoms except for a small area in the extreme south of Madras Province and the cardamom gardens of North Kanara. The former area was invaded in 1941, but the latter still remains free from the pest. Its effects were very serious and in many areas reduced crops to barely a third of their former level, and the capsules which were harvested were marred by scab tissue resulting from feeding injuries on the young developing fruitlets. The insect has, however, proved susceptible to benzene hexachloride and use of this insecticide has led to quite spectacular crop increases.

The virus disease, evident as a mottling of the leaves and gradual decline of the plants, is less spectacular, but is capable of rapidly wiping out a plantation unless careful attention is given to regular roguing. Its original appearance is wrapped in obscurity, but it appears first to have attracted attention in North Kanara. It is now present in nearly all districts, though its importance is very variable.

There is, in addition, a number of minor diseases and pests which occasionally flare up and cause damage. One of these, the caterpillar of an eupterotid moth, sometimes occurs in enormous numbers and strips the foliage from whole areas with an efficiency almost the equal of a swarm of locusts. In some areas, particularly in Coorg and Mysore, such outbreaks appear to have a periodicity of some 10 to 12 years.

Cardamoms and coffee

In Mysore, and to a lesser extent in Coorg, cardamoms are grown as a secondary crop in coffee estates, normally only in the moister ravines. Methods of management are broadly similar to those employed on pure cardamom estates. The area and the care and attention devoted to them has depended very largely on the fortunes of the main crop. In the late thirties there was a noticeable tendency to extend the cardamoms and to under-plant them further up the sides of ravines which carried coffee. With the improvement of the coffee position since the war, and with seasons unfavourable to cardamoms, this tendency has been largely arrested. Nevertheless, coffee estates still produce a substantial amount of good quality cardamoms.

Crops, harvesting and preparation for the market

Cardamom crops vary very greatly in size, being much affected by climate, more particularly by the rains between December and March, which are very variable in quantity. Crops of 100 lb. an acre of dried capsules are considered very good, but they are usually lower than this; 40 to 70 lb. an acre would represent the more usual level of good crops under the plantation system.

The capsules are harvested just short of full ripeness, before the pericarp turns yellow, and are then dried either in the sun or in specially constructed kilns. The dried capsules lose some 75% of their fresh weight in the course of drying. Sorting on a size basis is usually carried out at assembly centres by the merchants. Cardamoms are sometimes bleached with sulphur, but this practice is not as widely practised as it once was.

Apart from the classification by size, cardamoms are also classified by shape, long cardamoms usually being derived from the more robust Mysore variety and round cardamoms from the Malabar variety. It has been a cause of much confusion that the latter type is the principal type grown in Mysore, whereas the former is characteristic of the Travancore cardamom areas. It is probable that this anomaly arose from the fact that the trade of the Malabar coast in cardamoms was originally based on the round types grown in Mysore, whereas the Travancore cardamoms usually moved eastwards to assembly centres in Madras.

Use and commerce

Cardamoms are used as a spice and masticatory and are also employed to some extent in medicine. In India they find their way into curries and are handed around in Indian airlines at taking off along with cloves and boiled sweets. The chief overseas markets are in Scandinavian countries, Great Britain and the U.S.A., where, apart from their medicinal uses, they find their way into spiced bread and cakes, liqueurs and sauces and pickles. The oily extracts are not very important medicinally, though they are included in the official British and U.S. pharmacopoeias for their carminative effects and as a flavouring to cover more disagreeable draughts.

Prices have recently been high as a result of the combination of an increasing demand and a series of low crops. While diseases and pests have played no small part in reducing yields, there is no question that the series of dry seasons, which have played such a disastrous part in the food economy of Southern India, have also been of major importance to the fortunes of this small but valuable industry of the Western Ghauts.

Soil Conservation in Non-Self-Governing Territories

GOVERNMENTS responsible for the administration of non-self-governing territories are coming to realise more and more that raising the standards of living of the peoples of these territories depends to a large extent on soil preservation and fertility and on the improvement of depleted lands. This is one of the conclusions of a report* on land erosion in non-self-governing territories prepared by the UN Secretariat.

Describing in some detail the measures taken by governments to check soil erosion and soil exhaustion, the report concludes that there is a growing realisation that soil conservation is bound up with improved farming and proper utilisation of land, and for success comprehensive planning for whole agricultural areas is required. And this, the study notes, ' may involve sweeping social and economic changes.' Successful area plans, it was found, require co-operative efforts between individual farmers and community action, under the guidance of government agencies, that might involve ' drastic modifications in land utilisation and great changes in agricultural practices.'

The degree of development of the inhabitants of any specific territory influences the nature of government guidance. It varies from outright intervention based on compulsory directives backed by legislative provisions to simple education and field assistance. In practically all of the territories the first approach to soil conservation is through education, propaganda and demonstration.

Although the problem exists in many countries, the report indicates that non-self-governing territories are especially susceptible to soil erosion and soil exhaustion because of a number of factors. Most of the territories lie in the tropics or sub-tropics, where during a considerable part of the year temperatures are high and rainfall heavy; their soils, especially on the slopes, are liable to rapid erosion unless protected by vegetation. In areas of low rainfall and semi-arid regions damage occurs because of wind-blown sand and the formation of shifting sand dunes. Improper management of livestock is responsible for great erosion losses in the native areas of Africa, where traditional emphasis is placed on the number of animals. A reduction in livestock numbers through sale and slaughter has been attempted in such territories as Uganda, Nyasaland, Basutoland and Swaziland.

Other aspects of erosion include uncontrolled bush burning, faulty drainage in the construction of roads and railways and erosion caused by mining and building operations.

Corrective legislation enacted

Varying degrees of legislation and ordinances have been enacted in many of the territories to ensure the application and enforcement of conservation measures wherever they are necessary. In some cases, the report points out, it consists of simple 'enabling ordinances' which provide powers to make regulations for enforcement of conservation measures, while in other cases the legislation provides for the establishment of conservation authorities for the whole country.

The report goes on to explain in some detail legislative and practical measures employed in various territories to check the advance of soil erosion. ' The authorities responsible for the administration of non-self-governing territories,' it states, ' are faced with the task of devising methods appropriate to the various regions, each of which is unique because of the combination of physical conditions peculiar to it and of the populations having widely divergent needs, aptitudes and customs.'

The report contains information on measures taken in territories administered by Belgium, France, the United Kingdom and the United States.

Since 1946, there have been special committees appointed by the General Assembly to examine reports on the economic and social well-being of the peoples of the non-self-governing territories. As with the report reviewed here on soil conservation, the Secretariat first prepares summaries and analyses of the information for presentation to the committee. Governments responsible for the administration of the territories submit their reports under Article 73 (e) of the Charter, which provides for the regular transmission of information relating to the economic, social and educational conditions in the areas concerned.

* ' Soil Conservation,' Doc.A/AC.35/L.160.

The Evolution of the Mouldboard Plough

NORMAN L. GOODLAND

The origin of the mouldboard plough goes back to very ancient times, and in this paper the author traces its evolution in England from Norman times to the present day.

THERE is magic in the plough—it tells many things. Its style, its manner of use tells the state of the soil, and the culture of the people who use it; for the soil makes the culture, and the plough is the bridge between them. The task of the plough is to make the initial turning of the soil, from which all other operations begin. The share carries it to the depth required, and the turning is carried out by that large, shining curved blade called the mouldboard, turnfurrow, or plough-body.

It is in the turning of the earth that the key to modern agriculture lies; for it has long been regarded as one of the main factors conducive to maximum, medium, or inferior yields.

The evolution of the mouldboard plough

So apparently simple, this primal operation has been pondered upon by men connected with the land for centuries. Mouldboard designs with which we are today familiar have been worked out only within the last half-century. Always with the proviso that the nature of the land is the basic factor with regard to design, modern mouldboards are made to suit an agriculture geared to provide for an industrial civilisation. So does the plough, even today, tell us not only of the soil, but of the culture of the people who live upon it.

The evolution of the mouldboard is a story fascinating to all thinking men connected with agriculture. But its culmination in modern designs has not entirely disposed of problems connected with its use, for not only do problems with regard to its efficiency continue to perplex the modern engineer, but questions are today being raised as to the advisability of using it at all!

Belgic-Roman-Saxon mouldboards

The mouldboard was introduced to Britain just over 2,000 years ago by incoming Belgic tribes. They brought the first deep-cutting plough, the first to turn the sod over. Drawn by several pairs of oxen, the wooden mouldboard was strengthened against wear by pebbles jammed into holes drilled in the sides. From these times up until 1850 wooden mouldboards were widely used in the south and south-west of this country, and may even be found in use here and there at the present day. The principle of their work is to lift the furrow slice upon its edge, after which it topples over under its own weight.

In Roman times, much corn was grown in the south-east of the country; ploughs were light and simple—to suit the small individual holdings customary at that time. These were fitted with stout iron teeth to turn the soil cut by the share to one side or the other.

The Saxons used a heavy wheeled plough drawn by a team of eight oxen in pairs. The mouldboard was a very solid wooden beam behind the share, which directed the sods to left or right as desired. Naturally, it was a most unwieldy implement to turn, and the furrows were therefore not straight, but in the shape of a long, backward 'S.'

Norman times

In Norman times, both wheel and swing (or wheelless) ploughs were used, and a good deal more attention was now paid to the mouldboard. Their use was still only to guide the fall of the upturned sod. They were still single or double straight pieces of wood, but they were now clouted or plated against wear, and this was seldom very smoothly done. The Gloucestershire long plough, illustrative of the principle of guiding the fall of the upturned furrow, is, of course, of a much later date and there is a certain amount of curve in its shape.

By the time of Henry VII the forerunner of the old Kentish Turnwrest had been invented. At the end of each furrow the mouldboard on this plough could be moved over to the other side, thus avoiding the difficulty of throwing a furrow uphill when ploughing across a slope. The Kentish Turnwrest was to continue in use until well into the 19th century. A swing turnwrest from Sussex is shown in the accompanying illustration; it is far different from the great Kentish Turnwrest, but it shows the principle of the reversible mouldboard.

Views of Walter Blith

About 300 years ago we first hear of the double mouldboard. Through the cen-

Sussex turn wrest plough. The mouldboard is detachable and at the end of the furrow it was taken off and fixed on the other side before returning

turies draining of cultivated areas had become an increasing problem, and we hear of a draining plough of this time which could cut a drain 14 in. deep. The famous 17th century agriculturalist, Walter Blith, severely criticised mouldboards in common use on heavy ploughs. His opinion was that the share, coulter and mouldboard should all be made and set to follow the natural cast of the furrow. All joints, clouting and plating should be smooth and tight. He thought that the ploughs with a one-piece share and plate over the wooden mouldboard, modelled on the Dutch bastard plough, were best.

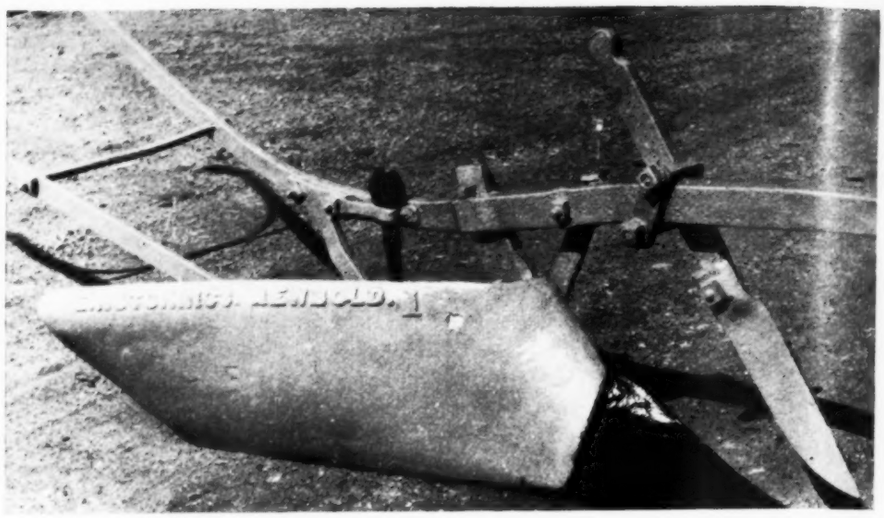
His criticisms of current mouldboards were that they were too 'thick in the breast,' that they were straight instead of curved, that irons were dull, or there was no clouting or plating, or clouting so rough that more friction was caused than by plain wood. A glance at the illustrations will show that even 200 to 250 years later, ploughs in general use were still not without these faults.

Iron and 'Winding' mouldboard

Half a century later, the great heavy ploughs against which Walter Blith spoke were still much used, but in Norfolk cast-iron mouldboards were being made. In 1716, a plough was found by Mortimer at Colchester which he thought 'very peculiar,' because its mouldboard was made of iron instead of wood, and rounded, which helped to turn the soil 'better than any other sort of plough.' Drainage still was a great problem, and in 1727 ploughs with double mouldboards for drain-cutting were in use. We again hear of a 'winding' mouldboard in 1730 on the Rotherham plough, but it was a wooden one covered by an iron plate, coulter and share being made of iron. Small's Scotch swing plough, with its cast-iron mouldboard and beam and handles of wrought iron, appeared in 1760.

Experiments with draining ploughs continued. The two most notable were Arbuthnot's, which had two blades following each other and cut a drain 16 in. deep, and Knowle's great double-mouldboard plough of the Isle of Wight, which in heavy land took 20 horses to draw it. The mouldboards were set side by side behind a huge central flat share, both turning the soil outwards.

In 1773, John Brand of Lawford, near Manningtree, Essex, made an iron swing plough for two horses. He made other iron ploughs for six horses which could plough up to 2 ft. deep. Lighter ploughs with curved mouldboards were in common use in the home counties, side by side with the great eight-ox ploughs which Blith criticised a century earlier.



Warwickshire iron plough. Detail of mouldboard and share (1870)

Iron or plated mouldboards were now well established, and in 1774 there was an early attempt to modify the iron mouldboard in order to reduce friction. It was fitted to a swing plough, and had a semi-circular section cut out of the bottom, with two small wheels put in at the ends of the section.

James Small and the mouldboard curve

The year 1784 saw another notable agriculturalist turning his attention particularly to the mouldboard. This was James Small. He said that to make a really efficient one which pleased the ploughman and was not hard on the cattle was a matter of knowledge and skill; and that a well-constructed mouldboard should do three things. It should hold the plough in the ground, remove the earth to the furrow side, and turn it over. The turning should start at the point of the share, which should curve into the mouldboard 'without any interruption or sudden change.' From the point of entry to the inversion of the furrow, share and mouldboard should follow closely the natural turn of the earth. The Gloucestershire long plough, though excellent in its way, hardly conforms to these essentials!

With the old Scotch plough as his

Huntingdonshire plough. A very heavy plough with a wooden mouldboard used in the heavy clay of Huntingdonshire

Gloucestershire long plough. An all-wooden plough from the clay land of the Vale of Tewkesbury. It is nearly 15 ft. long and was usually pulled by five Suffolk Punch horses

standard, Small made tables measuring the natural twist of the earth, and scales showing the width of curve of the board according to the width and depth of the furrow. In other experiments he used planks to represent the furrow slice, watching and calculating their movements as the mouldboard turned them over. His ploughs became very popular in parts of Scotland, and were hardly improved upon for 20 years.

Another noted agriculturalist, Lady Stewart of Goodtrees, also made improvements on the old Scotch plough, and produced the Rutherglen plough, which was claimed to be as good as Small's.

Multiple mouldboards and ploughs on heavy soil

We are now at a period of 170 years ago. Attention was shifting to double and even triple-boarded ploughs for general use upon all but heavy soils. Lord John Somerville, working upon the West of England double-boarded ploughs, by demonstration and experiment proved their efficiency, their superior speed, and their economy in haulage.

Upon clayey soils, however, the heavy wooden ploughs still held their own at the beginning of the 19th century. There were sound reasons for this. Many were fitted with mouldboards of pear or applewood, because the close grain prevented the clay from sticking, and this type of grain wore down smoothly and regularly. Other types tended to wear into ridges, as in the Gloucestershire long plough. Such ploughs, which Massingham called the ' mediaeval long plough,' remained in use to within living memory, and no doubt are still in use here and there. He said in his book, *Country Relics*:

' It was ideal for heavy land . . . it was much easier for the horses than the iron plough, and there were no wheels to lift it up and down among the clods. The ploughman gauged the right depth by his eye, and he had to keep the plough directly behind the team. Granted that, it was a grand plough, and there was none to equal it when the soil was like birdlime. By the setting given to the wrest, it could make a wide furrow without treading the unploughed land, so that the next cut would be easier. It could plough three-quarters of an acre in a day and had been accustomed for 30 years to plough 50 acres each year. On a farm where horses were plenty and the land heavy, the mediaeval long plough was cheaper, more efficient, and altogether easier to run than either the iron plough or the tractor.'

Anyone who has tried to use a tractor on even light clay in moderately wet weather will see the force of this. This is the Gloucestershire long plough, which is preserved in the Museum of English Rural Life at Reading.

The search for a general all-purpose mouldboard

In 1802, Lord John Somerville made a mouldboard in three pieces, which could be adjusted to suit any conditions of soil. In view of the three main modern types of plough-body, this is of especial interest. 1808 saw James Bailey working upon Small's developments from the old Scotch plough. He based the shape of his mouldboard upon a furrow-slice $4\frac{1}{2}$ ft. in length, twisted over as in ploughing. He also made calculations regarding the angle of entry of the share into the earth, according to the line of draught.

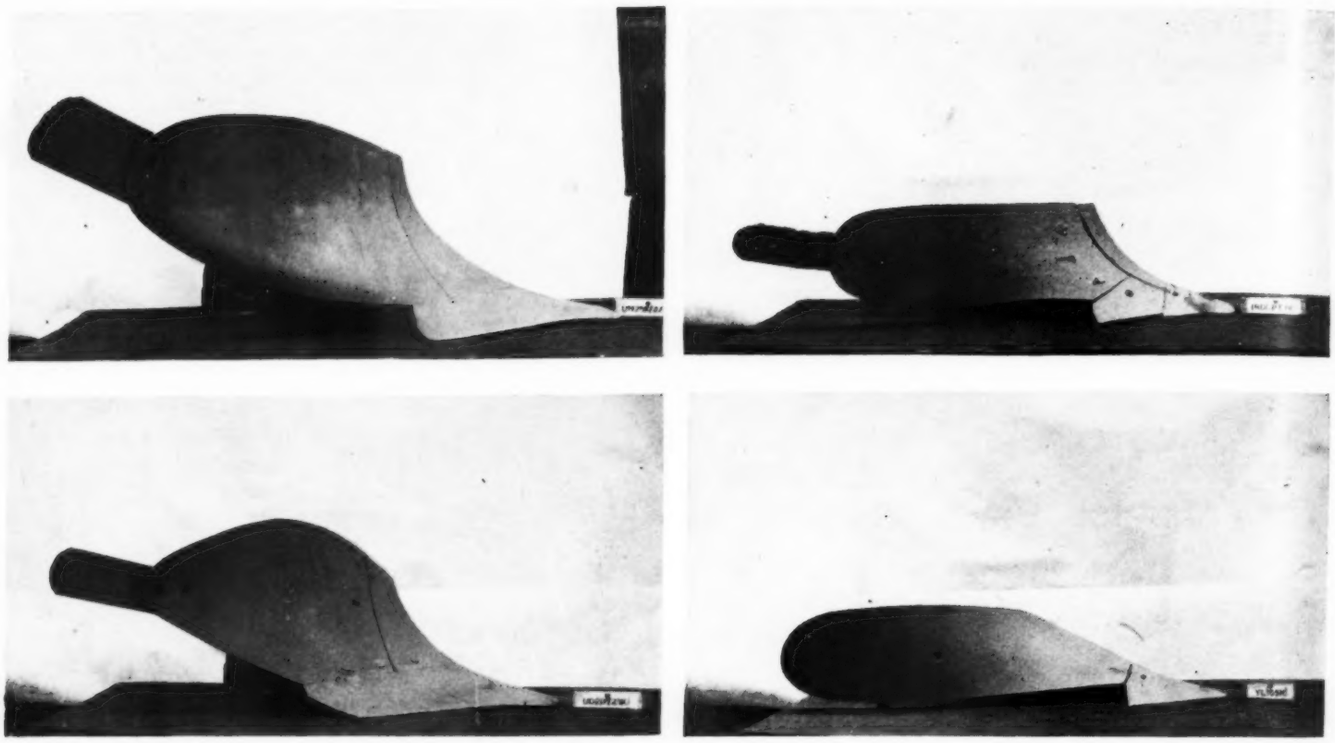
In this year also, a name well known in the agricultural world of modern times made its appearance. Robert Ransome took out a patent for making mouldboards which could be taken to pieces and repaired in the field. This same Ransome had patented self-sharpening shares 13 years earlier, the principle of manufacture being the same to this day.

And yet, in 1810, after all this work upon the mouldboard, after Blith, Small, Bailey, Lord John Somerville and Robert Ransome, it was complained by Captain Thomas Williamson that the mathematical principles of plough and mouldboard design remained unknown.

The first half of the 19th century saw mathematicians and scientists intent upon finding the most efficient shape for the mouldboard. A spring steelyard was used by Amos to measure the resistance of various types. It appears that what was being sought was a general design to suit all soils and localities. As a result of this search, mouldboards much improved, but by 1843 there was still no generally agreed ruling as to its proper shape. According to Thomas Williamson, most were too high and had too great a swell in the breast. He recommended that the upper part of the board should be concave, in order to turn the furrow at an angle of 45°. It was J. Allen Ransome, grandson to Robert Ransome, who observed that when ploughwrights made out their designs, they took into account the type of soil the ploughs were to be used upon, and that it was obvious different soils required different types of mouldboard. He said that it was useless to search for one general set of principles, and pointed out that the short, concave mouldboard used in Norfolk was not suitable for parts of Essex, where the long, convex board had proved to be more efficient.

'General purpose' and 'digger' type mouldboards

Experiments continued. Lord John Somerville was still busy with his double-boarded ploughs, and in 1831 perfected a very good plough of this kind with long, narrow mouldboards giving the ' ploughing-match ' finish, and easier to draw through the soil.



(*Top left*) **Deep-digging mouldboard, 35½ in. by 17 in.** (*Top right*) **Semi-digging mouldboard, 28 in. by 10½ in.**
(*Bottom left*) **Digging mouldboard, 29½ in. by 16 in.** (*Bottom right*) **General-purpose mouldboard, 35 in. by 9½ in.**

Then at last, in 1837, J. Allen Ransome evolved two main types of mouldboard which would be suitable for all purposes. These were very similar in design to the two main types made today by the firm of which he was one of the founders, under the name of ' General Purpose ' and ' Digging ' types.

From then until the present day the principles of mouldboard construction in Britain have changed very little, although they have, of course, been modified since the age of steam onwards to meet the mechanisation of the land. It must not be supposed that the ideas of Ransome and other prominent ploughwrights were at once adopted throughout the country. Every conceivable type remained in use, from the old Cornish sull with its straight wooden board, to the latest general purpose and digging bodies. Indeed, the common Welsh plough had no mouldboard at all; only a stick attached to the right heel of the share and angled back to the rear of the implement. And, of course, the original Scotch plough was still in use, with Small's and Lady Stewart's improvements, and so was the basic Rotherham.

Extant examples of old mouldboard types

Some of these can be seen today in many museums about the country. The national Museum of English Rural Life at Reading is building up an excellent collection. We see there the Gloucestershire long plough described by Massingham with its wooden mouldboard for use on stiff soils; an all-wooden one-way plough from Sussex, with its mouldboard in two parts, each part having been carved from a solid piece of wood, and a double-mouldboard wooden ridging plough from the same county. The Sussex turnwrest is there, its mouldboard having an iron tip, also used for heavy soils, and drawn by three horses in tandem. Yet another example of a heavy wooden plough is the Huntingdonshire plough at this museum with a beautifully shaped mouldboard quite on the lines of the ' general purpose ' type of the time.

The age of steam caused further modification, and more pronounced ' digger ' types were invented. The Marquis of Tweedale in 1851 shortened the mouldboard and caused its curve to be more acute than usual.

Fream's description of the two types of mouldboard

So closed the 19th century with this one great improvement in the work of the plough—the turning of the furrow. In *Elements of Agriculture*, Wm. Fream, LL.D., said that ploughs until the time of writing (1911) had no radical changes in the principle of their construction since the early part of the 1800s. He also described the two forms of mouldboard, general purpose and digging types, and the furrow slices which can be made with them, as they are today by the skilled ploughman who understands exactly what he is doing.

The 19th century Warwick iron plough carries the general purpose mouldboard, which gives a long, unbroken furrow slice, suitable for fields which need the additional drainage provided by the hollow beneath the slice, or for winter ploughing, when cultivations are not to take place for some time.

An example of the short digger type is the Turk of Newbury's plough. Its quick turnover tends to pulverise the soil, and thus make it possible to plough much nearer to the time of cultivation, and also makes the cultivations much easier. As far as horse ploughs are concerned, mouldboards have hardly altered in shape or principle since the time Fream wrote about them in 1911.

Modern designs for mechanical haulage

Few ploughs are today drawn by horses. Mouldboards have been modified accordingly, but they are still known as general purpose and digging types. In tribute to the work and experiments of Robert

(*continued on page 408*)

Ramie Fibre

Its Cultivation and Development

S. G. WILLIMOT, Ph.D.(Cantab.), B.Sc., F.R.I.C.

Among the fibre crops which have attracted attention in the post-war period is ramie (Boehmeria nivea). *Efforts to develop ramie as a plantation crop have met with fluctuating fortunes, but in spite of this there is still considerable interest in the crop today and pilot schemes for its development are in existence or under contemplation in widely scattered areas of the tropics.*

RAMIE, rhea or China grass is the product of species of the genus *Boehmeria*, a member of the family *Urticaceae*. It is closely allied to the common stinging nettle, from which it differs by the absence of stinging hairs. Although ramie may be grown over a wide range of soils and climates, it is typically a crop for tropical or near tropical conditions.

History

It is well known that the use of ramie dates back several thousand years and was originally confined to China, Indonesia and India. It was grown to obtain the fibre present in the inner bark, which, after hand processing, was woven into a variety of textiles. Long before the introduction of cotton, ramie was well established as one of the principal plant fibres of the Far East. Although archaeological evidence indicates that cotton was grown and used in the valley of the Indus in north-western India as far back as 3000 B.C., its introduction into China was only consolidated as late as A.D. 1300. In view of the difficulties of communications, it is perhaps not surprising that ramie culture was not known in Europe, Africa or America until many centuries later, although an exception to this may be the south of Russia, where, according to Nestor's Chronicles (900 B.C.), sails of ramie cloth were employed for ships on the Volga.

Some records report the occurrence of ramie fibre in Egyptian mummy cloths dating back to the 15th dynasty; but the authenticity of this claim seems doubtful and authorities believe that the fibre has probably been confused with flax. It is possible, however, that the fibre was known to the Romans.

In Europe, ramie was first recorded in 1723, when it was introduced into the botanical gardens of Holland as an ornamental shrub without any knowledge of its textile properties. In 1737, it was described by Linnaeus on specimens obtained from China and in 1809 ramie was grown experimentally in northern Italy.

By the middle of the 19th century ramie plants had become widely distributed throughout Europe, North Africa and North America and the great strength of the fibre appreciated. By that time textile mills in England and the Continent were successful in degumming and weaving the small consignments of the raw fibre (China grass) from the Far East, imported mainly for the manufacture of gas mantles.

At about the turn of the century a successful ramie enterprise was developed on the imperial estates at Chakva, near Batum, in the Caucasus. Both climate and soil suited the crop admirably, the soil of this low-lying locality probably being a fertile alluvium. The resulting fibre, in considerable quantity, was sent to the Government paper mills at St. Petersburg, where it was used in the manufacture of rouble notes and bills of exchange.

Modern development

Prior to the last world war considerable development occurred in the cultivation of ramie as a field crop and industrial processes for the extraction of the fibre (decortication and degumming) had been worked out in the Philippines, Formosa, Japan, India and the United States. The incidence of war served to renew interest in ramie, especially in North and South America. In spite of this the economic development of the crop over the last decade has been slower than was anticipated, but interest in its development is now widespread throughout tropical regions.

A stand of young ramie

Requirements for development

The requirements for the establishment of a ramie industry fall under two main heads:

(*a*) *Agricultural.* The successful production of ramie as an economic field crop.

(*b*) *Industrial.* Satisfactory technical processes for decorticating and degumming the fibre.

It seems clear that, in general, greater success has attended efforts to overcome the problems of agricultural production than the problems of industrial methods for extracting the fibre.

While this reflects the present position, developments in the world demand for textile fibres and the invention of improved processes for fibre extraction and degumming seem to have placed the future of ramie on a more promising basis. The uncertainty of the world market for ramie has been a factor in retarding development, but with the existence of new regions of production and an expanding demand it seems reasonable to believe that obstacles will disappear.

Properties and uses

Certain characteristic properties of ramie fibre (filasse) render it peculiarly valuable

for specific purposes. It is the strongest plant fibre known, it is equal to silk in natural brilliance and lustre, and the fibre is exceptionally long. It is scarcely affected by water and the atmosphere and shows good resistance to many solvents and to dilute acids and alkalis. Ramie fabrics stand up well to perspiration, washing and detergents and the fibre dyes readily. Wherever strength, toughness and hard-wearing qualities are required in a fibre, ramie may be legitimately thought of.

In spinning, its principal drawback is the difficulty of securing uniformity of length of staple, a technical point which no doubt can be overcome. Ramie textiles, being somewhat lacking in elasticity, also show some tendency to crack and break when sharply bent. This has been successfully overcome by combining ramie with other fibres when weaving them into cloth.

The utilisation of ramie fibre falls into two categories:

(*a*) Local use.

(*b*) Industrial use.

Local uses by native populations include ropes, string and fishing lines, nets and fabrics (' grass-cloths '), binding material and sewing thread. Industrial uses comprise textiles generally, table and household linen, laces, furnishing and bedding textiles, sewing thread for leather goods, fabric for motor tyres, gas mantles, packing material, ropes and tow, filter cloths and paper for bank notes. This by no means exhausts the possible industrial applications of this fibre, but gives some idea of its range of uses.

Climate

Ramie requires a warm, moist climate and flourishes in tropical and semi-tropical regions. It thrives where the winters are cool enough to ensure a resting period, but not a prolonged dry season. Severe frosts and repeated thawings can greatly damage the root system and kill the plants. Ramie is a sun-loving plant and there is as yet no evidence that it requires shade. It grows to a height of 5 to 7 ft. The possibility that the crop under tropical conditions might benefit from light moving shade requires further investigation. A mean maximum shade temperature from 90° to 95°F. during the growing season is necessary. Once it is well established ramie can survive severe drought, but it requires abundant moisture during growth—more than maize, cotton, tobacco or most other field crops of the tropics or sub-tropics—as well as abundant sunshine. Unless irrigation is practised, as in California, the minimum rainfall for economic production is about 50 in. per annum, well distributed over the growing season. Ramie is intolerant of waterlogged soil conditions and will not endure inundation for any length of time.

A stand of ramie in Sao Paulo, Brazil

Varieties

Of the two varieties available, white ramie (*Boehmeria nivea nivea* (L.) Gaud.), which is characterised by the white under-surface of the leaves, is more suited to tropical and sub-tropical conditions. It gives higher yields of green canes with a high content of spinnable fibre. Varieties of ramie are known which are capable of withstanding a wider range of climatic conditions, as, for example, the frost-resistant clones reported from Russia and Japan. Some new selections, presumably indigenous to the Philippines, have also given satisfactory results in the U.S.A. Research in plant breeding will no doubt evolve new clones suited to local conditions.

Soil types

Ramie is an adaptable plant and, somewhat contrary perhaps to prevailing ideas, it can thrive on a number of soil types. In general, it does very well on fertile sandy loams or alluvial soils possessing good drainage yet capable of retaining moisture. The silty loams of Lintonia, Louisiana, are stated to have yielded up to 92,000 lb. of green canes per acre per annum. During the 25 years that ramie has been under observation on the peat and muck soils of the Florida Everglades the plant has shown itself to be eminently suited to this soil type. These soils are loose and fibrous, rich in organic matter, extend to 12 ft. in depth; they are often drained by means of an ingenious system of mole drains.

For the free development of the rhizomes the soil structure should preferably be crumbly and friable in order to allow of easy root penetration and rhizome development, as well as of ready infiltration of rain water. Adequate aeration is essential, but soils should be sufficiently retentive to supply the needs for water of the growing plants. The surface layer of soil should be a foot or so in depth, while sub-surface layers should extend to some feet and have a similar structure and retentivity as the top-soil. On the other hand, soils to be avoided are stiff heavy clays, swamp soils with impeded drainage, droughty soils and types with impermeable subsoils. The plant is extremely sensitive to traces of salt in the soil or irrigation water. The water table should not rise above 2 ft. below the ground level, although during periods of very heavy rainfall the water table may rise almost to the surface of the soil for a matter of hours without damaging the crop.

Topography

In order to allow of a high degree of mechanical cultivation, lands chosen for cultivation should be flat or at least not more undulating than a tractor and harvester can easily negotiate.

Propagation

Ramie is propagated by rhizomes carrying several buds. An area planted in 1949 in the State of Selangor, Malaya, using rhizomes transported from Penang in damp sawdust, gave an almost 100% strike.

It is not practicable to grow ramie from seed. Although seed is produced in large quantities, the majority is infertile and the few which are fertile give rise to a heterogeneous collection of plants with wide variation in fibre content. This suggests that the two known species are in reality heterozygous unfixed clones and in com-

Transporting decorticated ramie fibre for packing and shipment

mercial production plants are always propagated vegetatively.

Planting

In planting, rows may be set out from 3 to 6 ft. apart and the individual plants in the row from 15 to 24 in. apart. In general, planting distance may be wider on rich than on poorer soils.

Fertilisers

Ramie has justifiably earned the reputation of being an exhausting crop, but fertility can be maintained by:

(*a*) Returning to the soil leaf and other refuse from harvesting and decortication.

(*b*) The proper use of fertilisers.

Ramie reacts quickly to fertilisers, the right use of which not only increases the yield, but improves the quality of the fibre. In general, it has been found that ramie requires the three major plant nutrients as a complete fertiliser for a basic dressing. The components are best supplied as ammonium sulphate, superphosphate and muriate of potash. That the crop definitely responds to potash has been demonstrated on the muck soils of the Everglades, while in experimental trials in Malaya on mineral soils there was a similar response. Organic fertiliser may also have a favourable effect on crop growth.

Fertiliser treatments should also include the minor elements copper, manganese, zinc, boron and possibly magnesium, at least on peat soils. In the case of peat never previously fertilised, Neller recommends a dressing of copper sulphate at the rate of 75 lb. per acre with subsequent annual dressings of 25 lb.

The first application of fertiliser should precede the planting of the rhizomes. The application of fertilisers is best carried out by placement in the furrow or drill, after which a double mouldboard plough is used to mix the fertiliser with the soil. The rhizomes are then dropped in the furrows at the required intervals by machine and covered. To avoid damage to young shoots, after the last harvesting of the season, subsequent annual applications of fertilisers are broadcast soon after the canes have been cut and well in advance of new growth.

Cultivation

After planting about four cultivations are given. Until the plants reach a height of about 2 ft. inter-row cultivation to control weeds is essential. The growing plants should then provide sufficient shade to keep down competitive growth. In a well-managed crop on good soil no cultivation should be necessary after the first cutting, as the new canes should grow faster and thicker than the weeds. This eliminates weeding, which materially decreases costs.

Harvesting

Clean, straight and unbranched canes are required. They are usually cut at least once during the first year and left to rot on the ground in order to induce a thicker and stronger growth in subsequent crops. Depending on soils and climatic conditions, a period of a year or more must elapse before the first crop of canes can be taken for fibre production. The canes from the first crop are usually taller but produce coarser fibre; the second and third crops yield finer fibre but contain more gum.

Although no hard and fast rule can be laid down, the optimum interval between cuttings is about 60 days. Under tropical conditions this allows of four and even five crops of ramie per annum over a period of eight to 12 years with the yields steadily declining. The life of a ramie plantation depends upon the original fertility of the soil, the methods adopted to conserve it, the general management of the crop and the climatic conditions.

Some experience is necessary to decide the right time for harvesting. The criteria are as follows:

(*a*) When active growth has ceased, coinciding with the formation of staminate inflorescence.

(*b*) When the green epidermis commences to turn brown from the base of the stem upwards.

Fortunately mechanised harvesting offers no problems. The ordinary tractor-drawn reaper binder, with power take-off, or the power-driven mower, using the ordinary oscillating cutter bar, are both satisfactory.

Processing

For the production of ramie fibre plant is required for the decortication and degumming of the fresh green canes. Because of the tonnage involved and the risks of spoilage after harvesting it is essential that this be done somewhere in the proximity of the ramie plantations. In the U.S.A., decortication is carried out in the field by mobile decorticators or in a factory by static decorticators; in all cases the canes are treated in the green state.

The curing of ramie canes in the field by stooking is not feasible because the heat and high humidity lead to moulding and decay with resulting damage to the fibre. For this reason, decortication in the green state is the most economic procedure and fibre thus extracted and degummed is of excellent quality. Experience, however, has recently proved that, provided mould growth is superficial, the ramie fibre on decortication remains undamaged.

Retting cannot be recommended for the decortication of ramie, since it is unreliable, slow, unpleasant and difficult to control, while the fibre tends to disintegrate by over-retting. The advent of chemical degumming has now superseded retting, except with the smallholder in China and Japan.

Pests and diseases

At present there are no known diseases of ramie of economic consequence. In Malaya, root rot occurred only in waterlogged soils. In the Florida Everglades, Neller records that ramie roots have been singularly free from pests such as wireworms and nematodes. The aerial parts of the plants are susceptible to damage by leaf-rollers and grasshoppers to some

Decorticated ramie fibre ready for baling

degree. In Malaya, damage was caused to a slight extent by mole crickets; in the Southern Sudan there was some attack by grasshoppers and snails; and in Australia the ravages of black beetle (*Phyparida discopunctulata*) were obviously more serious. In the latter cases it has been shown that the pest can be controlled by the use of sprays containing gammexane or lead arsenate.

Yield

The yield of green cane, and hence of ramie fibre, varies widely, depending on such factors as climate, soil, moisture, fertilisers, age of plants and cultivation. The average crop expectancy may be taken to lie between 60,000 lb. and 75,000 lb. of green material per acre per annum. Maximum yields of 80,000 lb. to 95,000 lb. reported in the U.S.A. must be regarded as exceptional and unique. The *Encyclopaedia Britannica*, 1929, gives a figure of 4 tons of green canes per acre, allowing two to four crops per annum, and representing an average of 12 tons or approximately 27,000 lb. per acre per annum.

In Malaya, some of the best of the experimental sub-plots in Jeram Estate yielded at the rate of 18,000 lb. per acre per annum for three cuttings, but with four cuttings the figure could be expected to rise to more than 10 tons per acre. From the results of field trials in Australia it was considered that with three cuttings the total annual yield of green canes was of the order of 20 tons per acre. In China, there are no reliable field data on the yield of ramie cultivated by hand labour as a peasant crop.

As regards the yield of clean, spinnable fibre in different ramie-growing countries, the available data are:

Per cent. clean fibre (filasse) of harvested green canes	
U.S.A.	3%
Malaya	3%
Australia	5%
Average (Thorpe) ..	2.5%

With improved cultivation and more efficient decortication it is possible that these yields might be increased.

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Photos: (except p. 405), Brazilian Government Trade Bureau, London.

WORLD CROPS

IN OUR NEXT ISSUE, the **Official Control of Husbandry in Great Britain** will be described by R. B. Whaley, and the **Development of Spraying Machines** will be discussed by R. J. Coursheе. Other articles will include the **Cotton Industry in India** by S. Ramanath and **Cobalt Deficiency in Pastures** by David Le Roi.

Colorado Beetle Campaign

The Ministry of Agriculture and Fisheries has announced the successful completion of the 1954 Colorado beetle precautionary spraying campaign, one of the most important measures necessary to prevent the beetle establishing itself in England. This year's spraying programme was carried out according to plan. Approximately 17,000 acres of potatoes in Surrey, Kent and Essex were sprayed by ground machines or helicopter during the period June 14 to July 29.

The Evolution of the Mouldboard Plough

(*continued from page* 404)

Ransome, his son James, and his grandson J. Allen, the latter coming to the conclusion that these two types of mouldboard were the answer to a search for a standard, I propose to describe those made by the modern firm of Ransome, Sims and Jefferies Ltd., of which the above gentlemen were the forerunners.

This firm makes two types of mouldboard, general purpose and digger, but divides the latter into three further types. Their long general purpose is slightly convex, with an easy turn. This sets up the work into slices as described by Fream in 1911, and in addition to the reasons Fream describes for that type of ploughing, the general purpose is used at ploughing matches because of its pleasing finish.

For practical usage, however, their more convex 'semi-digger' is increasingly put to general use, for it is adaptable for ploughing lea, stubble and after-root crops, and to change from the flat share used in general work to the high-cut for grassland, only a different wing and point are required. By adjusting speed, the 'ploughing-match' effect is obtainable with the semi-digger.

The 'digger' is used for deep ploughing, because its action is almost complete inversion and pulverising, and the illustrations show also the deep-digging body.

Such is the evolution of the mouldboard. Yet difficulties remain in close work to fences and hedges with mechanically hauled ploughs. E. V. Twose of Tiverton, Devon, has estimated that as much as 10% to 12% of cultivatable land is lost in this way, and has manufactured a headland plough, with a single mouldboard offset to the near side of the tractor, in order to recover this loss. But as regards trailer equipment, the problem of close ploughing to hedges and fences is not solved.

Photos: Pp. 401, 402, 403, The University of Reading, Museum of English Rural Life. P. 404, Ransomes, Sims and Jefferies Ltd.

The Cultivation of Blueberries

E. R. WEBBER

CULTIVATED varieties of blueberry—a native North American wild fruit—are now being grown in considerable quantities in America and Canada and trials with them are being carried out in several European countries. The fruit can be marketed fresh or used in the canning and quick-freezing industries. The plants like an acid soil and will often thrive on land unsuitable for other crops. The fruit crops late in the season when other soft fruit is finishing. These factors make it a useful crop in many areas.

The name blueberry can be used to cover several species, but in commercial horticulture it is used to designate the group of plants commonly called blueberries and sometimes huckleberries, which have small soft seeds in contrast to the true huckleberries, which have large hard seeds.

Blueberries, which include a number of species* Vaccinium, *are indigenous to the continent of North America where the genus has been domesticated and has obtained wide popularity in the U.S.A. and Canada as a garden fruit. It has not obtained popularity in Europe, although it has been introduced into the United Kingdom. It remains to be seen whether its popularity will in due course develop.

History of the domestication of the crop

The first commercial planting known was of the rabbit-eye blueberry, a wild species from the south of the United States. This was made in Western Florida in 1893 by Mr. A. Sapp, who transplanted bushes from the wild. In 1906, the late F. V. Colville began experiments with the highbush varieties and breeding work began in 1909. Later he was helped by Elizabeth C. White, of New Jersey, and the modern commercial blueberry industry is founded upon the work done by these two people.

Types of blueberry

Seven types or species of blueberry grow extensively in different parts of the United States and three others are found on a smaller scale. In Eastern Canada also the blueberry has been a favourite fruit since the first white settlers arrived. It also grows wild to a lesser extent in Western Canada.

Lowbush (*Vaccinium augustifolium Ait*). This is one of the most important commercial species, especially on higher ground. The bush grows to a height of 6 to 18 in. and the fruit ripens in July and August over most of the United States and in September further north.

Highbush (*Vaccinium australe* Small and *Vaccinium corymbosum* L.) These species do not stand drought well and grow best in swamps, moist woods and other damp places. They grow from a single large woody crown and under favourable growth conditions can reach a height of anything from 10 to 15 ft. They grow wild in many parts of New England as well as over a wide area from South Maine to South Michigan and southwards to South Georgia.

The highbush species are increasing in popularity for commercial work. Plants bearing fruit of large size were selected to form the basis of most present-day varieties. Most of these were named after the men on whose land the plants were first found. Thus we get Harding after Ralph Harding, Sam after Samuel Lemon, Adams after James Adams, Rubel after Ruben Leak and Grover after Russel Grover.

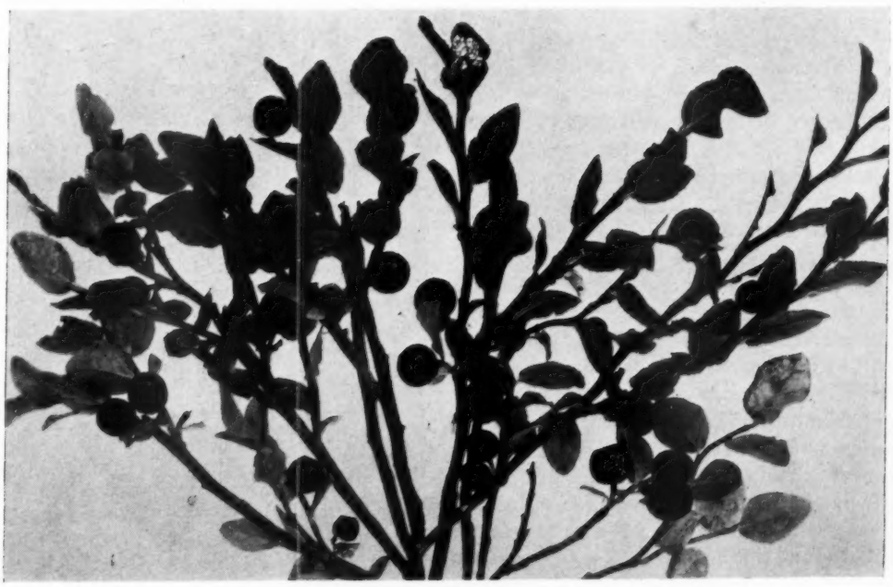
In recent years many of these selections have been hybridised to form the very large-fruited varieties which are grown extensively at the present time. Rubel, for instance, was crossed with Grover to produce the well-known variety Jersey.

Dryland (*Vaccinium pallidum Ait*). This species, also known as the 'low huckleberry,' is from 1 to 3 ft. in height and is later in fruiting than either the highbush or the lowbush. Its ability to do well in dry conditions may make it an important species in the future. It is native to North Alabama and Georgia and northwards to Maryland and West Virginia.

Evergreen (*Vaccinium ovatum Pursh*). This is also known as the 'coast huckleberry' and is grown more for the beauty of its foliage than for its berries. These latter are usually small and shiny black with a characteristic strong flavour different from all other blueberries. These berries are, however, excellent in pies. The shrub itself is not very hardy. It is found along the Pacific coast from Central California to British Columbia.

Mountain (*Vaccinium membranaceum Druge*). Known also as the 'broad-leaved huckleberry,' this species is very drought-resistant, but no commercial plantings of any size have yet been carried out. It is native to the high slopes in Oregon and Washington and eastwards towards Wisconsin.

Rabbit-Eye (*Vaccinium ashei Reade*). Native to South Georgia, Alabama and



Vaccinium myrtillus—**the whortleberry, native to England**

North Florida, this species is more heat- and drought-resistant than most of the other species.

Soil requirements

Most blueberries thrive in naturally moist, acid soil in a pH ranging from 4.0 to 5.5. The highbush species do best in a pH of 4.3 to 4.8.

An open porous soil is preferred, such as a mixture of sand and peat plus some loam, with the water table 15 to 30 in. below the surface. In other soils these conditions can often be brought about by the use of sprinkler irrigation, the application of sawdust as a mulch and the liberal application of sulphate of ammonia. By these means it has been found that blueberries can sometimes be economically grown on soils to which they are not at all naturally adapted.

All species are moderately susceptible to spring frost damage.

New land should be cleared and cultivated for a year before planting takes place. Drainage should be undertaken, if necessary, to keep the water-table well below the surface during the growing season. Though the blueberry requires moist conditions, it will not thrive with continual waterlogging of its roots.

Propagation

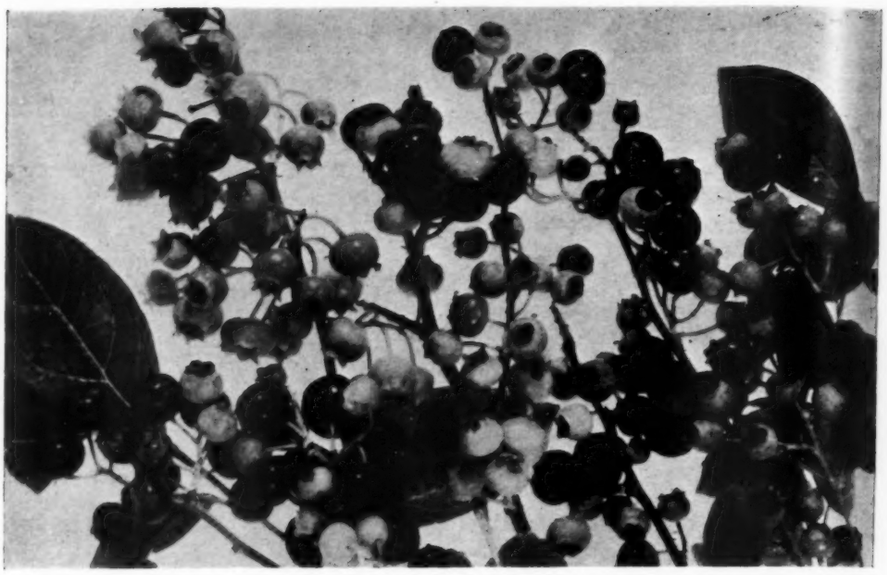
The lowbush types are usually propagated from offshoots or suckers and generally grown in nursery beds for a year before being set out in their permanent quarters. Cuttings, both softwood and hardwood, may be taken in summer and winter respectively. The highbush types are usually propagated from hardwood cuttings taken about 4 to 6 in. long from dormant shoots of the previous season's growth. The lower cut should be made just below a bud and the upper just above one.

Softwood cuttings, if used, should be taken when secondary growth first appears in the new shoots. Length should be about 4 in. and only two upper leaves left on the cutting in order to reduce transpiration (some growers even cut these remaining two upper leaves in half). Highbush cuttings are grown for a year in nursery beds before being planted out in their permanent quarters. The rows in the nursery bed are usually about 18 in. apart and the plants 6 to 10 in. apart in the rows.

After a year in the nursery the plants are known as two-year-olds and well-grown plants of this age are considered the most suitable for commercial work.

Blueberries may also be raised from seed and for this purpose the berries are picked when fully ripe and kept at a temperature of approximately 50°F. for one week. They are then pulped with sifted sand and the mixture sown as soon as possible. The compost for these seeds usually consists of two parts peat and one part good blueberry-growing soil. The mixture of sand and seed is sown rather thickly and covered with about $\frac{1}{8}$ in. finely sifted pure sand. The boxes or pots are kept in the shade until germination takes place, which is generally in five to six weeks. From then onward the boxes must be kept well watered and taken under cover as soon as there is any sign of frost.

In the spring, when all danger of frost is past, the seedlings are transplanted to a cold frame and left there until the following spring, when they will be ready for planting out into their permanent quarters.



Vaccinium corymbosum—**the Highberry blueberry**

Vaccinium corymbosum—**variety Jersey**

Planting

Early spring is the more usual time for planting, though in some districts, notably British Columbia, autumn planting is preferred.

Fairly wide spacing of the plants is now the usual practice; 8 ft. by 8 ft. will allow the use of a narrow tractor for cross-cultivation and will give maximum production after about eight years; 4 ft. by 4 ft. will give higher initial production, but also entails higher initial cost and the plantations soon become overcrowded; 8 ft. by 6 ft. is a compromise adopted by a few growers. At least two varieties of blueberry should be planted in fairly close proximity in order to ensure adequate cross-pollination. At least every fourth row should be of a different variety from the main crop.

Cultivation

Clean cultivation is usually practised for the first year or two. The cultivation itself should be fairly shallow, especially near the roots, and should cease altogether at the end of the summer, so that growth may cease and the new twigs mature before the winter sets in.

The use of fertilisers depends on the kind of soil. Sulphate of ammonia, which is acidic, is most commonly used, but occasionally a complete fertiliser is given. Mulching with leaves, sawdust, hay or straw to a depth of 5 to 6 in. helps to retain moisture, keep down weeds and keep ground cool. The mulch can be spread over the whole surface or just around the plants, but care should be taken not to have it touching the actual plant.

A close-up of variety Jersey

Pruning

The blueberry produces its fruits on the previous season's growth and the largest fruits are borne on the most vigorous wood. Most varieties have a tendency to produce too much fruit and in order to get a large crop and to allow sufficient growth for the following year's crop a certain amount of pruning must be done.

Very little need be done until the end of the third year. Some thinning out of weak twigs and the removal of the fruit buds to keep the plant from bearing fruit will be all that is necessary. At the end of the third year some of the old wood can be cut back or removed altogether. The plants should be of good shape with no low branches which will allow the fruit to touch the soil and get dirty and make cultivation difficult. Older plants have a tendency to produce short, weak shoots and small berries. These should be removed and in a healthy plant some of the shoots with a superfluity of buds should also be taken off to allow better development of the remaining buds. New growth should always be encouraged.

Harvesting

Blueberries do not ripen evenly within the cluster and, since it is necessary to pick only mature berries from each cluster, the entire planting must be picked over several times. The ripe berries will hold on to the plants for several days, however, which gives the grower a little leeway in which to organise his picking.

The mature berries are a dark, rich bluish colour at the stem end. A reddish tinge at this end indicates immaturity. For the fresh market the berries are usually picked into gallon cans and taken to collecting points, where they are sorted. All bad, immature or damaged fruit should be removed and the saleable fruit transferred to containers of the type used for strawberries. Each of these containers is then usually covered with cellophane and 12 containers are made into one crate. Four crates are then nailed one on top of each other with cleats. A lid is placed on the top crate and they are ready for despatch to market.

One man can pick between 65 to 100 lb. of berries in an eight-hour day when the crop is heavy. This requires two men per acre at the beginning of the season, five to eight men at the peak and two again at the end.

Varieties

Most cultivated blueberries are hybrids or selected plants of the native plants of North America. The following are some of the most widely grown:

Rancocas. Tall, vigorous, with upright plants which tend to over-bear, so need severe pruning. It is propagated easily from hardwood cuttings. The fruit is large, light blue, firm and of good quality. It travels well, but is not so good a keeper as some of the others.

Scammel. Erect and vigorous with the fruit large, dark blue and firm with a slight aroma. It is above medium in dessert quality. Leaves are small and the fruit clusters long and tight.

Dixi. Vigorous, open, spreading bushes with very large berries which are medium blue, firm, aromatic and of good quality.

Rubel. A tall, vigorous, upright plant and very productive. It is the easiest of all standard varieties to propagate from hardwood cuttings and is also quite easy to propagate from softwood cuttings. Fruit is only medium in size, light blue, very firm and slightly aromatic. Fairly good quality and travels well.

Atlantic. A very promising large-fruited plant giving an excellent crop. It is very vigorous with a spreading, open bush and large leaves. The clusters of berries are loose, while the fruit itself is large and firm with a slight aroma. Above average in quality.

Pemberton. The most vigorous plant of all. Very erect and propagates easily. Fruit is large, dark blue, firm with a slight aroma and quality is good. Leaves are large and the fruit clusters loose and very large.

Jersey. A vigorous and upright plant. This variety is somewhat objectionable because many of the stems tend to adhere to the fruit during picking operations. This makes it necessary to remove many of the individual stems from the fruit before placing them in the basket, thus increasing the cost of the picking. Fruit is large, attractive, firm and keeps well. It remains acid and of good quality until mature. The stems are long and the clusters open.

Burlington. A vigorous and spreading plant with fruit of medium size, a good blue colour, firm with slight aroma and above medium in quality. Clusters are medium tight and the plants are easily propagated.

Among promising new varieties are:

Weymouth. The earliest of all varieties, ripening all berries quickly. Fruit, however, is poor in quality, above medium in size, dark blue, firm and with little aroma. The bush is erect, open, spreading and of average vigour. Fruit clusters are fairly loose and the leaf is above average size.

June. Below average in vigour, erect with medium-sized leaves, fruit clusters loose, fruit medium in size, dark blue with slight aroma, medium quality. Difficult to propagate.

Cabot. This is the standard for earliness in the State of New York, where it is being planted extensively. The bush is below average in vigour, low and spreading. Fruit clusters are long and tight, the fruit of a good blue colour, not very firm, slight aroma and rather poor texture.

Pests and diseases

When fields were small and isolated plantings remained relatively free from pests and diseases, blueberries were hailed as the one crop free from these troubles. But in recent years, with modern plantings in large fields of genetically similar bushes, disease has spread rapidly. The most serious of the diseases at the present time are stunt, mummy berry, botrytis, powdery mildew and stem canker. The most serious pests are blueberry maggot,

currant fruit weevil, blueberry leaf beetle and flea beetle.

Blueberry growing in Great Britain

The blueberry is allied to our native whortleberry, of which many acres are found on Exmoor, the Quantock Hills and elsewhere. Up to the time of the second world war many tons of whortleberry fruit were despatched each year from a collecting centre organised under private enterprise at Porlock.

In 1948, E. W. Hollis took over a small collection of highbush blueberries which had been imported from Canada and which were growing on acid heath in Dorset. The named varieties included Rubel, Burlington, Jersey, Pemberton and Rancocus. A new site for these plants was found on Exmoor, where rainfall was 44 in. and pH 4.5. The plants were grown in both wild and garden conditions. Those grown in the wild were unsuccessful owing to damage by rabbits, but the others, which were protected by netting, produced a good crop of large well-flavoured fruit in the third and fourth years after planting.

The most successful varieties were Rubel, Jersey, Burlington and Pemberton in that order.

It is not yet safe to assume that blueberries would be a profitable crop in the United Kingdom, but, as and when more suitable varieties are produced, they may prove a good crop for acid soils which are often unsuitable for other crops. The great increase in their popularity in Canada and America may spread to Europe.

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Photos: Long Ashton Research Station.

A Primitive Survival

A 'survival curiosity' of primitive character may be observed at Branscombe on the coast of south-east Devon, England, where seaweed required for fertiliser on cliffside plots of early potatoes is carried up from the beach by pack donkeys. The cliff paths are too steep and narrow for any other form of transport to be practicable. Seaweed is used in several parts of Britain, but at seaside resorts it is sometimes a nuisance and a problem, because of its smell and the flies which it harbours.

Australian Farm Mechanisation

From our Australian correspondent

The Bureau of Agricultural Economics, dealing with a recent Commonwealth survey of mechanisation of wheat farms, states that the importance of farm machinery in the Australian agricultural programme has been widely recognised, and considerable efforts have been made by Governments, machinery manufacturers and producers' organisations to improve the supply position, which in the early post-war period had become critical. The limitation of imports and of local manufacture during the war had prevented farmers from carrying out replacement of worn-out machines, the average age of plant on farms was steadily increasing and maintenance costs were rising rapidly. The efficiency of operation was also being seriously affected, for, in addition to frequent breakdowns, further delays were caused by the difficulty of obtaining spare parts.

It is now found that between 1949-50 and 1952-53 the average value of machinery on surveyed farms rose from £1,768 to £3,445, an increase of 95%.

The greatest increase in numbers has occurred in tractors. There are now almost one-third more tractors on wheat farms than in 1949-50. Truck numbers have also shown an appreciable increase. The greatest proportionate increase in numbers is in pick-up balers and crop-spraying equipment, in both cases starting from very low initial figures. These machines are a new technical development on Australian farms and were virtually non-existent in 1950. The large proportionate increases in hay rakes, mowers and shearing plant reflect both increased pasture improvement and the trend towards sheep raising in agricultural areas. It is interesting to note that there has been a large proportionate increase in scarifiers, contrasting with a small rise in numbers of ploughs, and a decline in tine cultivators. This reflects the change in cultivation practices on many soils where scarifiers are displacing ploughs for initial working. The change in numbers of scarifiers has also been partly the result of the greater availability of these implements.

There has been a substantial decline in the use of reapers and binders and of stationary hay balers. This last decline is, of course, due to the technical superiority of the pick-up type of baler, while the decline in reapers and binders can be attributed to the decreasing production of cereal hay and the displacement of sheaf hay by baled hay.

Only a slight increase has occurred in the number of headers and harvesters in use. Most farms would have use for only one of these machines, and such new purchases as have been made would have been for the replacement of very old implements.

Unicellular Algae as a Source of Food

M. J. GEOGHEGAN, M.Agr.Sc., Ph.D.

I.C.I. Ltd., Jealott's Hill Research Station, Bracknell, Berks.

The possibility of world population increase outstripping human ability to produce sufficient food for its support has caused attention of late years to be turned to the utilisation of previously unexploited resources and materials. These have included the culture of certain algae, on which work has been done both in the United Kingdom and the United States. The following article, reproduced with some abbreviation from 'Discovery,' by permission of the Editor, describes work carried out at Jealott's Hill in this connection and discusses the possibilities of the method.

THE world's population is increasing at a faster rate than output from agriculture and a time may come when some of our food may have to be produced by unconventional methods. One suggestion is to culture unicellular algae.

Having noticed their remarkably rapid growth rate and the extent to which their biochemical composition could be varied, some American workers started, about six years ago, to consider the possibility of culturing these organisms on a large scale as a source of food. While the idea of mass culture of algae is new, their utilisation as a source of food is old. Our forefathers fed marine algae to their livestock, and the Japanese are renowned for the delicacies which they have made for centuries from seaweed. The possibilities of the mass culture of unicellular algae have been studied in many countries, notably the U.S.A., Japan, Germany, Holland and England.

Like other green plants, algae obtain energy from sunlight, carbon from carbon dioxide and nitrogen from inorganic nitrogen compounds, but the amount of food they produce per acre can be very much higher than that from agricultural crops. Photosynthesis can only work at optimum efficiency when the other requirements for growth are fully satisfied. Algae growing in culture solutions in enclosed containers can be easily supplied with all the nutrients they require and in the correct proportions. In the case of agricultural crops, which are at the mercy of the weather, it is usually impossible to satisfy exactly all their requirements. In addition, the whole of these unicellular plants can be harvested and utilised, while only a part of the crops that the farmer grows is usually reaped.

Another advantage with algae is that it may be possible by suitable agitation of cultures to expose the algal cells to intermittent light, which is used more efficiently than continuous light. Most higher plants cannot be crowded so closely together and, especially when a crop is in the seedling stage, a large amount of the sun's energy falls on bare ground. Wastage of sunlight occurs, too, when long periods elapse between harvesting one crop and sowing the next.

Algal species

It appears that very many species of algae could be cultured on a large scale as a source of food. *Chlorella pyrenoidosa* has been tried in America and Germany, *Chlorella ellipsoidea* in Japan and *Chlorella vulgaris* var. *viridis* at Jealott's Hill, but these are not necessarily the best, and attempts are being made to find more promising algae.

Chlorella vulgaris is a unicellular plant whose cells are spherical. The diameters of the cells of the strain used in our experiments at Jealott's Hill range from 3 to 10 microns. There are four distinct stages in its growth cycle. First, there is a lag phase, when cell division is very slow; secondly, an exponential phase, which is characterised by rapid cell division, decline in average cell size and a decrease in the dry weight per cell; thirdly, a period when the rate of growth is more or less linear and not so great as in the exponential phase; fourthly, a period when increase in cell number is replaced by cell *expansion*. In the exponential phase the number of fully-grown cells is doubled every nine hours.

Chlorella reproduces by division of the cell contents into daughter cells; two, four, eight or 16 of these are formed within each cell and are later liberated. In rapidly growing cultures only four daughter cells are usually produced per cell.

In *Chlorella* cultures a marked increase in cell number may occur without corresponding increase in dry matter—due presumably to cell division—and, conversely, a marked increase in dry matter may occur without an attendant increase in cell number, due presumably to cell expansion.

When ideal conditions are provided, growth occurs at a maximum rate. The limiting factor is not the rate of photosynthesis, nor the rate of nitrogen assimilation, but some other process, as yet unknown.

Culture technique

The growth and biochemical composition of *Chlorella* species are influenced by many factors, some or all of which are interrelated.

Culture vessel. The choice of the right container is highly important. In the laboratory, many different types, varying from test tubes to large perspex tanks, have been used. Polythene tubes somewhat similar to those used in pilot-plant studies in the U.S.A. are perhaps the most feasible for large-scale production. This type of plant is said to be much cheaper than metal, concrete or wooden troughs. Open ponds probably require the least capital expenditure, but it would be difficult to keep them clean, obtain high utilisation of carbon dioxide and provide adequate stirring.

Culture medium. Chlorella thrives on a strictly inorganic diet. Nitrogen, phosphorus, potassium, magnesium, sulphur and iron are the major requirements; ammoniacal nitrogen is preferred to nitrate nitrogen. It does not appear to require calcium. All the minor elements known to affect plant growth are usually added to the culture media, and some of these, especially iron, are kept in an available form by adding chelating agents.*

Chlorella has been cultured at hydrogen-ion concentrations ranging from about pH 5 up to about pH 9. In many experiments the pH has been allowed to drift, following the uptake of nutrients, from about pH 5 up to pH 8. Now the tendency is to maintain the pH at about 6.

*A chelating agent is an organic compound capable of reacting with metallic ions to form a cyclic complex in which the metal atom forms part of a ring and is held claw-like between two groups of the molecule.

The optimum temperature for *Chlorella vulgaris* and *Chlorella pyrenoidosa* is about 25°C. At 20°C. and at 30°C. growth of *Chlorella vulgaris* is very poor and cultures must be heated or cooled as the air temperature varies. The cost of heating and cooling may be reduced by culturing the algae in a region with a mild climate and by selecting species or strains which will grow well at reasonably high temperatures (*e.g.* 30° to 35°C.). Other results have shown that some species of *Chlorella* can tolerate higher temperatures if they are kept cool at night.

Supply of carbon dioxide. *Chlorella* absorbs carbon dioxide principally in the undissociated form. The amount of carbon dioxide in the atmosphere is insufficient for maximum growth of *Chlorella* species. Experiments on the effect of carbon dioxide concentrations on photosynthesis show that carbon dioxide saturation is reached when the carbon dioxide content of the gas phase in equilibrium with the culture solution is 0.1% and that concentrations above about 5% are toxic. However, once the consumption of carbon dioxide in a culture is known, it should be possible to feed gas mixtures containing high concentrations and still maintain within the desirable limits the CO_2 content of the gas above the culture. This may be the cheapest method in large-scale production. It is perhaps worth noting that at Jealott's Hill we have successfully used gas mixtures containing 20% CO_2, the organism being cultured in open vessels.

Light. In most laboratory experiments with unicellular algae artificial light is used. However, any large-scale process would, for economic reasons, have to depend on daylight. Only light of wavelengths shorter than about 7,000Å is active in photosynthesis and thus only about half of the solar energy falling on the earth's surface is capable of being utilised by plants or algae.

Cells grown in weak light are usually smaller than those grown in strong light. On this account cells are usually small when the population density of a culture is high.

At Jealott's Hill, we have compared the growth of *Chlorella vulgaris* in continuous light with that when the cultures were illuminated for different periods every day, and we have found that keeping the cultures in darkness had a beneficial effect on growth in the subsequent light period—the yield per litre per unit of light was increased. Unfortunately, chloroplasts use light most efficiently when the intensity of illumination is low. It has been shown that maximum efficiency is achieved by *Chlorella* at 100 foot candles. This phenomenon of

Photomicrograph of *Chlorella* cells

light saturation imposes a serious limitation on the efficiency with which solar energy can be utilised by algae. It has been calculated that only 20% of the energy in the visible spectrum of sunlight is used photosynthetically, the remainder being wasted as heat, and that a twentyfold increase in the incident energy results in only a fourfold increase in the amount utilised by the algae. There are two possible ways of solving this problem: firstly, by isolation or adaptation of algal strains to use bright sunlight efficiently; and, secondly, by illuminating algal cells intermittently.

At the University of Texas, a strain of *Chlorella* is being studied which has a much higher saturation intensity. This might give about twice as great a yield per unit area of culture as the strains now used.

Experimental culture tank used at Jealott's Hill for growing *Chlorella* on a fairly large scale. The sides of the tank are of polythene

Many years ago it was observed that the rate of photosynthesis in algal cells is much higher in flashing light than in continuous light. This suggested that yields from mass cultures might be considerably increased if intermittent illumination could be obtained by suitable adjustment of culture depth, agitation and population density. Conditions should be such that every cell is moved to the surface of the culture, exposed there to light for a given length of time and then returned to the interior of the culture, where it remains in total darkness for a definite period of time. It has been calculated that in full sunlight the yield might be increased *sevenfold* by this treatment.

In flashing light, the rate of photosynthesis depends on the ratio of light to dark periods and the length of these periods. One result indicates that the flash time must not be longer than a few milliseconds and that the dark time must be at least 10 times as long as the flash time for fully efficient utilisation of the incident light. Another suggests that the benefits of intermittent illumination can be obtained with flash times as long as 30 seconds.

As yet there is very little evidence that the correct pattern of intermittence in illumination can be obtained in large-scale cultures. Much more information is required before the value of intermittent illumination can be judged, and it is felt that the economical provision of turbulent flow that will submit individual cells to favourable flash patterns is probably an engineering problem.

Depth of culture. Optimum depth of culture will vary with light intensity and with the way the light is used. Laboratory tests have shown that yield of dry matter per litre is inversely proportional to depth of solution exposed to continuous illumination; therefore the yield per unit area is not affected by the depth of the solution.

A serious difficulty is that cells are non-motile and the cultures have to be stirred to obtain maximum utilisation of light, nutrients, etc. This agitation may prove to be one of the major operating costs associated with mass culture of algae.

Contamination

When culturing algae on a large scale it is impracticable to maintain sterile conditions and it may even be difficult to grow a pure culture of a single algal strain. Conditions which are suitable for, say, *Chlorella* are also more or less suitable for other algae, *e.g. Scenedesmus*, but this type of contamination should not seriously alter the value of the product. On the other hand, it is difficult for bacteria, fungi or actinomycetes, most of which obtain energy by

oxidation of organic compounds, to live in *Chlorella* cultures. The media used for growing *Chlorella* are entirely inorganic and only a very small fraction of the carbon fixed by these organisms is excreted into the medium.

Organisms which can engulf *Chlorella* cells are potential contaminants. At Jealott's Hill we have frequently noticed certain protozoa, such as ciliates, in our cultures, but, although they engulfed a number of cells, they did not appear to reduce the yield. Serious infestations of rotifers occurred in the American pilot plant.

Harvesting

Centrifuging the culture solutions is the only satisfactory method of harvesting *Chlorella* cells. This is a costly process and on a large scale involves considerable capital investment. Costs might be reduced if cultures could be allowed to settle before treatment.

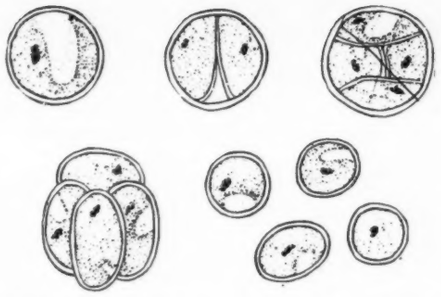
The paste obtained after centrifuging contains about 30% solids and decomposes in a short time if stored at room temperature. When dried, it keeps for long periods and retains its dark green colour if stored in the dark.

Spray-drying appears to be the most satisfactory method for large-scale drying of *Chlorella* cells. The VioBin process,* for simultaneous defatting and dehydration, could also be used for drying *Chlorella*. This separation might be very useful if the constituents of *Chlorella* cells were to be used separately.

Yield of dry matter

The many factors that influence the growth of *Chlorella* and the variety of culture techniques used by different investigators are responsible for the wide variation in the yields obtained. In experiments daily yields of about 40 grammes per square metre of irradiated surface have been obtained, which is much less than the theoretical maximum of 110 grammes per square metre (assuming complete utilisation of the visible spectrum of sunlight). On some occasions, under less favourable conditions, yields of 11 grammes were obtained in the American pilot plant. Extrapolation of pilot plant results suggest that an annual yield of 17½ tons per acre is not unreasonable to expect with the present technical knowledge. The wide gap between the yields obtained and the theoretically possible yield indicate the scope for improvement in culture techniques, etc.

*The VioBin process consists essentially of heating vegetable or animal material with a suitable organic solvent. Fats dissolve in the solvent while water is removed by distillation with the solvent vapour.



Cells of *Chlorella pyrenoidosa* in a rapidly growing liquid culture

Composition of dry matter

The composition of *Chlorella* cells is markedly influenced by the environment in which the organism is cultured. Thus the crude protein content may be varied from about 7% to 88%, lipoids (fats) from about 5% to 85% and carbohydrates from about 6% to 38% (on a dry matter basis).

Protein. So far most workers have aimed at providing conditions for maximum growth and this results in a product with about 50% crude protein and 47.5% true protein. It has been shown that *Chlorella* protein contains the essential amino acids.

Fat. Products with high lipoid contents can be obtained by keeping *Chlorella* cells for long periods in a medium containing little or no nitrogen. Under these conditions, the daily yield of dry matter per litre is very low and, although the percentage of lipoids in the cells is high, the yield of lipoidal material is no greater than that from rapidly growing cultures.

The percentages of fatty acids, unsaponifiable matter and water-soluble saponification products in the lipoid fraction of a sample of *Chlorella* cells (which contained 23% lipoids) were found to be about 28, 12 and 60 respectively. The percentage of true fat in the total lipoid fraction can be varied from about 30 to about 90.

The fat from *Chlorella* resembles that from other vegetable materials, but is slightly less saturated. It contains triply unsaturated fatty acids, which are rarely found in vegetable fats. Palmitic acid is the predominant saturated fatty acid; only small amounts of stearic acid are present.

Carbohydrates. Very little is known concerning the composition of the carbohydrate fraction of *Chlorella* cells or about the extent to which the composition of the fraction varies when the carbohydrate content of the cell is altered. Starch and sucrose have been isolated.

Ash. The total ash content of unwashed cells examined at Jealott's Hill was about 7.5%, but, since the centrifuged product contains about 30% dry matter, and since about 2% of this consists of salts from the medium, the true ash content was about 5.5%.

Chlorella cells contain more phosphorus, sulphur and magnesium and less potassium than grassland herbage. The iron content is about the same in the two materials. Examination of products obtained by a semi-continuous process and from a batch process showed that the percentages of inorganic constituents (notably phosphorus and potassium) in *Chlorella* cells were influenced by the composition of the nutrient solution.

Vitamins. Apparently the vitamin content of algal cells is markedly influenced by the age of the culture and conditions under which the organisms are grown. So far the vitamin content of *Chlorella* cells has not been thoroughly investigated. Carotene, thiamin, riboflavin, niacin, pyridoxine, pantothenic acid, chloine, biotin, vitamin B_{12} and lipoic acids have been found in products produced in the American pilot plant. The B-carotene content* of freeze-dried *Chlorella* cells is very high, being at least three times higher than that of good quality dried grass. From these results it has been concluded that dried *Chlorella* could be an important source of vitamins and that approximately ¼ lb. of dried *Chlorella* would provide more than the minimum requirement of all except vitamin C. There is as much vitamin C in fresh *Chlorella* cells as in lemon juice, one of the best sources of this vitamin, but, unfortunately, most of it is lost when the cells are dried.

Besides carotene, *Chlorella* cells contain chlorophyll A, chlorophyll B and xanthophylls. The chlorophyll content is influenced by light intensity and other factors affecting growth.

Feeding value

Much more investigation is necessary before the food value of *Chlorella* is fully known. Feeding tests carried out at the National Institute for Research in Dairying have shown that *Chlorella* protein is significantly better for young rats than yeast or groundnut protein, but is inferior to milk protein. The diet fed contained 17% *Chlorella*, which at this level had no ill effects on the animals.

In 1951, experiments were carried out at Maryland University to assess the value of *Chlorella* as a source of nutrients for chicks. The inclusion of 10% *Chlorella* in place of an equal weight of soya bean meal in a diet deficient in riboflavin, vitamin B_{12} and vitamin A resulted in a very marked increase in growth and improvement in feed efficiency of young chicks.

*This carotene is the precursor of vitamin A.

The improvement was attributed primarily to the high riboflavin and carotene content of the *Chlorella*. The addition of 0.1% *dl*-menthionine to the *Chlorella* diet also resulted in some improvement. Chicks fed with 2½%, 5%, 10% and 20% *Chlorella* developed impacted beaks and beak deformities, so that their food consumption and growth rate were lowered, possibly due to the hygroscopic nature of dried *Chlorella* cells. This could perhaps be overcome.

In 1952, a second chick-feeding experiment was carried out by the Ralston Purina Co., U.S.A. This time chicks received a ration containing 2.5% of *Chlorella*. The growth of chicks fed with *Chlorella* was very slightly depressed and apparently they did not eat as much food as the control group. Beak impaction was not a problem in this experiment.

In Venezuela, algal soups have been fed to leprous patients. The soups were prepared by harvesting mixed cultures of phyto- and zoo-plankton species and boiling the product with salt. Patients of all ages drank these soups and liked them. Adults usually got 600 ml. and children 400 ml. per day. The length of treatment varied from one to three years. In the majority of cases there was a marked improvement in the general health of the patients which could be attributed to better nutrition or to the presence of some therapeutic substance in the microbial cells.

Conclusion

Unicellular algae can be cultivated on a large scale and yields many times higher than those from agricultural crops can be obtained. The product has a very attractive composition and probably is a useful foodstuff, but so far nobody has estimated the cost of production. This aspect of the problem should be investigated because it now appears that the success or failure of the mass culture of algae is a question of economics.

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Illustrations: P. 414 (top), courtesy R. Brinsden, A.R.P.S.; p. 415, after 'Algal Culture', Carnegie Institution of Washington Publication No. 600.

South African Agricultural Developments

WE have recently received from our correspondent in Cape Town the following account of agricultural developments in the Union:

Vine sales

The July vine sale on the Paarl showgrounds was the most successful ever held there. About £20,000 of business was done. Last year's total was about £13,000. Bidding was keen for 'Queen of the Vineyard,' the first grape to reach the British market every year and which fetches the highest prices. Last year 'Queen' fetched the South African record price of £86 for 1,000 vines, but this year the best price for 'Queen' was £58, still an excellent price. Just behind was Le Roux hanepoot at £55, followed by White hanepoot at £52 10s., and Waltham Cross at £50.

One nurseryman sold 49,000 Hermitage on Jacques, which was a big offer for prices of £30 and above. This is a wine variety. There was a rumour that the K.W.V. might reimpose quotas and this might have had something to do with the keen buying. Growers got their money's worth, as the quality of the vines offered was a marked improvement on last year.

Orange varieties

Delicious new kinds of oranges to ripen after the Washington navels of autumn and before the Valencias of spring are being planted on a large scale by citrus farmers. So keen is the demand for these plants that the Subtropical Horticultural Research Institute at Nelspruit can give growers only 20 buds each of each new variety. Nor can nurseries keep pace with the demand. Experts describe these oranges of the future—Hamlin, Clanor, Tomango, Pineapple and Premier—as large, sweet and juicy, with thin rinds and fewer pips than the Valencia. The few that have been shipped to Britain fetched excellent prices. More than 20 years ago the research institute planted an orchard of 60 different mid-season varieties to see which would thrive, bear early and abundantly and provide high-quality export fruit. An even flow of oranges to the markets is needed all through the season. The output of navels reaches its peak about May 30 and the output of Valencias about September 5, leaving a mid-season gap. The result is a shortage of South African oranges overseas during the gap, followed by a rush of late Valencias at the end of the season, when the first oranges from the Mediterranean come on to the European markets. In the past few years it has become clear that the new varieties, which ripen during the gap, are what the Transvaal lowveld farmers have been looking for.

Sugar prospects

Sugar growers in the Natal coastal belt are busily engaged in the harvesting of this season's crop of cane. The supply of field labour appears to be satisfactory and consignments to the mills are consequently being maintained at a steady rate. The sucrose percentage of the cane is always poor at the beginning of the cutting season, but this year the content of early deliveries has in many instances been particularly low. This is attributable in part to the heavy rains which have fallen since the beginning of the year, and also to the mild temperatures experienced during the early weeks of the harvest. Dry, cold weather has now set in, however, and the sucrose content is expected to rise. Statistics quoted at the recent annual meeting of the South African Cane Growers' Association show the marked strides which the industry has made in the past 17 years. The output of sugar in the 1953-54 season was 725,429 tons, compared with 446,409 tons during the 1936-37 season. This represents an increase of 62.5%, although the acreage under cane rose by only 13.9%. The balance of 48.6% can be directly ascribed to a significant increase of 42.1% in field efficiency, represented by output of sucrose per acre, and an improvement of 6.5% in milling efficiency. Exports of sugar during the first four months of 1954 amounted in value to £1,500,000, compared with £200,000 in the same period of 1953.

New grape varieties

Farmers in the Western Cape are waiting to hear when a new type of white table grape from California, the Calmeria, will be released from quarantine by the Department of Agriculture. Cuttings off the vine were imported several years ago and sent to the Western Province Fruit Research Station, where they have been in quarantine ever since. It was explained by the head of plant control at Stellenbosch that until now the grape has been growing in a special greenhouse isolated from all other plants, but this season cuttings have been planted on a farm near Stellenbosch. The Department of Agriculture had to be extremely careful with all vines from California because of the occurrence of a virus disease there, Pierce's disease. If this disease got a hold in the Western Cape the effects would be disastrous. Thus before the authorities will release the vines they will be grown for a season in open quarantine. If they are satisfactory a small quantity will probably be made available to farms.

The Natal Wattle Industry

W. WILLIAMS, A.M.Tech.I.

In this article, the culture of South Africa's major forest crop—Black Wattle—is described. An account is also given of the important wattle bark industry which has been developed to meet the world demand for tanning materials.

THE black wattle (*Acacia mollissima*) was first introduced to Natal from Australia in the year 1864, the first seeds being planted at Camperdown by Vanderplank. The valuable tanning properties possessed by the bark had been well known in Australia for many years, but it was not until the year 1884 that the pioneer of the Natal bark industry, Sir George Sutton, first sold a few tons of wattle bark to a local tanner. Two years later, in 1886, the first small quantity of bark was exported to London, realising £11.

Development of the industry

From these small beginnings the trade in wattle products has grown to a total annual value of well over £7 million. Table 1 summarises the expansion of the export trade from its birth to the present day and, in addition, illustrates the transition from shipment of the dried bark only to a stage where locally processed wattle bark extracts dominate the export figures.

During this period the area under wattle trees in the Union of South Africa has grown to a total of some 600,000 acres. Natal predominates with over 400,000 acres planted, but other provinces of the Union, notably certain areas of the Transvaal, have also proved suitable for commercial wattle plantations.

Climatic requirements

A minimum annual rainfall of some 35 in. or more is essential to the successful growth of wattle, so that the so-called mist belt of Natal at an altitude of from 2,000 to 4,500 ft. has proved to be the best locality for large-scale plantations. This is in the summer rainfall zone.

Cultivation

Plantations are established on new ground by sowing seed collected from existing trees. After harvesting, the plantations are often re-established naturally from seeds accumulated in the soil. If seed is sown, the best months for planting are late January to March, when the midsummer grasses have been cleared. Wattle seed is hardy and no special strains have been developed. Soaking in hot water is necessary before planting to speed germination. From 2½ to 4 lb. of seed per acre are usually sown and germination occurs from two to four weeks later. Early thinning and spacing of the young trees is essential, the most vigorous plants being left whenever possible.

The crop requires most attention during the first couple of years' growth. Weed clearance and spacing are carried out so that the final tree density is from 400 to 600 trees per acre, depending on the site and the fertility of the soil.

The trees reach maturity in about eight years. After this time the yield of bark increases for several years so that the cycle on which trees are grown varies from eight to 12 years, the average being somewhat under 10 years.[1] When the trees are judged to have reached their most economic yield they are felled and the bark is stripped off manually. A good native stripper will harvest about 800 lb. of bark during a day's work. Stripping is usually carried out during the rainy season from October to March, as the bark will not strip off readily when the wood is too dry. All bark on the bole of the tree up to a point where the diameter is only 1 in. is merchandisable.

If the bark is to be used for direct extraction at a nearby factory, it is chopped into suitable lengths and bundled for transport to the point of processing. Otherwise, if it has to be moved long distances or milled for export, it is first dried at the plantation site. Drying must be carried out carefully to avoid deterioration of the bark due to mould growth or leaching out of soluble tannins by excessive rainfall.

The yield of dry bark from an average plantation runs to some three to four tons per acre, although in some cases these figures are nearly doubled. One factor which limits the yield of bark is the damage caused by the chief insect pest, the wattle bagworm, which is indigenous to native acacias.[2] The wattle bagworm (*Acanthopsyche junodi* Heyl.) causes serious damage, especially in plantations which lie outside the main mist belt. During the summer months this pest can cause almost complete defoliation of trees of all ages with consequent permanent stunting of growth. Another pest is a frog-hopper, a type of sucking insect. Control of these pests through the use of insecticides has achieved some success, but research is still in progress to ascertain the best methods of application to the trees.

Importance of wattle bark

Wattle bark is one of the world's major sources of vegetable tanning materials. Tanning reagents obtained by the extraction of wattle bark are classed as pyrogallol tannins because on heating they give pyrogallol. Other vegetable sources of tannins are chestnut and quebracho barks, which have been largely used in the U.S.A.; these are classed as catechol tannins.[3] It has been found that simple modifications to tanning liquors overcome any difficulties caused by the use of wattle extracts, while several advantages are also obtained, especially in the production of heavy leathers.

Because of the blight which has killed off American chestnut trees in recent years and also the increasing difficulty in obtaining quebracho from the natural forest areas of the Argentine, the strategic importance of the South African wattle industry is increasing. Exports of wattle products from the Union mainly go to the U.S.A. and the

TABLE 1
VALUE AND TONNAGE OF WATTLE EXPORTS FROM SOUTH AFRICA

Year	*Dry Wattle Bark*		*Bark Extract*	
	Value (£)	*Tonnage*	*Value (£)*	*Tonnage*
1886	11	—	—	—
1896	16,460	3,380	—	—
1906	89,374	14,828	—	—
1916	254,340	50,868	15,454	439
1926	591,241	80,441	325,926	18,207
1935-39 (average) ..	459,598	—	492,561	—
1940-44 (average) ..	441,069	—	1,079,311	—
1946	547,835	*c.* 55,000	1,418,141	*c.* 68,000
1952	720,512	22,770	6,653,453	93,000
1953 (11 months) ..	781,266	24,420	6,013,041	83,800

Note.—All tonnages are expressed in long tons of 2,240 lb.

United Kingdom, but smaller tonnages also go to many other destinations, including Australia, the Far East and various European countries.

The tannin content of dried wattle bark ranges between 30% and 40%; this is usually sold within a quite narrow margin around 36%. When exported directly the bark is milled and blended according to the specifications required and then baled for shipment, usually through the port of Durban. Today, however, the bark is further processed in Natal and a concentrated wattle extract is marketed for export.

Manufacture of wattle extract

The first wattle extract was produced at a Pietermaritzburg factory in 1916 as a result of the development of a satisfactory commercial process of extraction by Walters.[4] The particular importance of this process was that a solid extract was produced which could be packed in bags and transported without difficulty. Today, all wattle extract is marketed with a guaranteed tannin concentration of 60% or more.

Wattle bark extract is now manufactured by a counter-current extraction process whereby shredded bark is leached with hot water in a series of vessels. The resulting liquor is then clarified and concentrated by evaporation in multi-stage evaporators and vacuum pans until a point is reached where it solidifies on cooling. It is then run direct into jute bags on cooling racks, where the product is left to harden. Modern plants are constructed of copper, older vessels being wooden. Any iron must be carefully eliminated from the process because of the discoloration which occurs when tannin comes in contact with this metal.

Current exports of bark extract now exceed £6 million in value annually (see Table 1).

The uses of wattle timber

When wattle trees have been felled and the bark stripped a valuable by-product in the form of timber is left. An approximate yield of some 10 to 15 tons of usable timber can be expected per acre of plantation. Mature trees grow to some 50 ft. in height (greater if heavy thinning is carried out at an early stage of growth).

This timber is used extensively by the South African gold mining industry for making mine props. Timber suitable for props can be cut from the tree up to a diameter of 3 in., and large poles can be readily sold also. Under the warm, moist conditions prevailing underground at the mines wattle timber is highly susceptible to fungal attack. However, research by

Natal wattle plantation

scientists of the Transvaal Chamber of Mines Research Laboratories has led to the development of effective methods of preventing rot by the use of chemical preservatives.[5]

Large quantities of wattle timber are used as fuel throughout Natal, the trees, when cut up, making excellent firewood. Apart from these obvious uses, an important new industry has recently been established in Natal based on the processing of wattle chips. These are used to manufacture hardboard of great strength and durability and also insulation board. A factory is now in operation at Estcourt with an authorised capital of £1 million. Modern continuous production methods are used, the cellular structure of the wood is first disrupted by high-pressure steam and the resulting fluffy mass, when pressure is suddenly released, then undergoes treatment with various bonding agents. High pressures are then exerted in large presses to turn out a variety of hardboards which have proved very popular throughout South Africa, especially in the building and furniture trades.

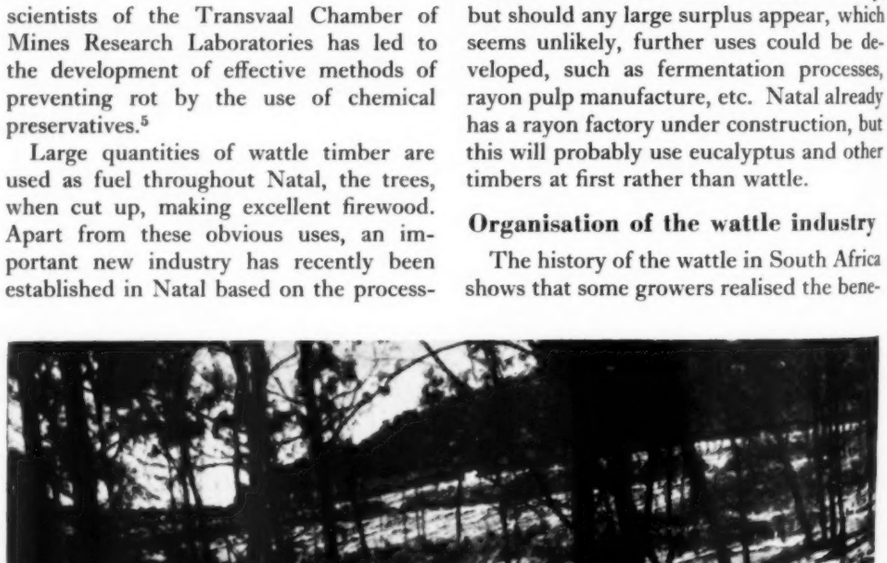
The South African paper industry is now also using considerable amounts of wattle timber. About 40% of wattle is incorporated in paper pulp along with other woods.

Because of its physical characteristics, wattle is not suited for making sawn planking and similar material. It is, however, used in the manufacture of treated fencing poles, parquet floor blocks, kitchen furniture, cable drums and charcoal.

The uses already enumerated consume the bulk of wattle timber available today, but should any large surplus appear, which seems unlikely, further uses could be developed, such as fermentation processes, rayon pulp manufacture, etc. Natal already has a rayon factory under construction, but this will probably use eucalyptus and other timbers at first rather than wattle.

Organisation of the wattle industry

The history of the wattle in South Africa shows that some growers realised the bene-



Felling trees and stripping bark

Stripped plantation showing brush piles and timber

fits of co-operation as far back as 1907, when the Natal Wattle Bark Union was first formed. This did not meet with a great deal of success and the industry had several different representative bodies until 1938, when the South African Wattle Growers' Union was reconstituted. This body has worked in close collaboration with the South African Wattle Bark Millers' and Exporters' Association and also the South African Wattle Extract Manufacturers' Association. Today, the industry is in a strong position and, while it has benefited by good prices for its products in recent years, it is looking to the future and sponsoring research into improved plantation techniques and uses for the product.

As a result of contributions by the Wattle Growers' Union and the Union Department of Education, the Wattle Research Institute was founded in 1947 at Pietermaritzburg as an integral part of the University of Natal. This institute is now jointly maintained by the Union Department of Forestry and the Growers' Union. It has a body of scientists continuously engaged in investigations connected with the wattle industry.

Prior to the establishment of the research institute valuable service was rendered to the industry by the chemists of the College of Agriculture at Cedara, including such pioneers as C. O. Williams[6], A. J. Taylor[7] and others. Extensive field work has been carried out by the Department of Agriculture and Forestry under the leadership of Dr. I. Craib.[2]

Another important aspect has been the development of the system of bark grading which is now enforced. All wattle bark intended for export is inspected and graded by a Government inspector before shipment. An official grading system had to be introduced because of the varying quality and consequent disputes which arose prior to 1936. As a result of extensive tests by Taylor and Goodwin it was shown that an experienced grader can evaluate bark visually with great accuracy and in close agreement with chemical analysis of the tannin content. Today, bark is shipped in three grades: prime with over 37% tannin, average with 35% to 37%, and merchantable with less than 35% tannin. Certain other factors also influence grading, such as colour, dryness and purity.

As a result of close co-operation between the growers, processors and Government departments, the wattle industry is now working efficiently and can look forward to the future with confidence.

Acknowledgments

In conclusion, the writer would like to acknowledge the help given by Prof. H. Shaw, Director of the Wattle Research Institute in making available much of the information upon which this article is based.

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FAO Catalogue of Grain Legumes

Following the publication of FAO Agricultural Study No. 21, 'Legumes in Agriculture' in 1953, the plant production branch of the agriculture division of FAO is now exploring the possibility of establishing a catalogue of those legumes which are primarily of value as human food. Such a catalogue would provide information which it was not possible to include in 'Legumes in Agriculture.'

Many species and varieties of the following genera contribute in varying degrees to the diet of people in most parts of the world, providing either proteins, oil or other nutrients: *Arachis*, *Cajanus*, *Canavalia*, *Cicer*, *Dolichos*, *Glycine*, *Lathyrus*, *Lens*, *Lupinus*, *Phaseolus*, *Pisum*, *Vicia* and *Vigna*. In other parts of the world where human food is deficient in quantity or quality grain legumes are considered to be the cheapest and best source of vegetable protein available. This is particularly true in countries which do not at the moment have an adequate supply of protein food, or where the population lives largely on a vegetarian diet. Perhaps the soya bean is the most important of these grain legumes.

FAO has, therefore, decided that a catalogue of the varieties of grain legumes would contribute to the general work of improving human nutrition, particularly in tropical and subtropical countries. Grain legumes are also useful for livestock feed, soil conservation and various industrial purposes. Within some types of legumes grown for seed or grain there are a very large number of varieties and the problem of synonymy complicates the work considerably, but in other countries the varieties of adapted grain legumes are few in number and in many cases have not been fully investigated.

The proposed FAO catalogue, giving a brief description of the biology, morphology, cultivation and nutritive value of seed and grain legumes is, therefore, thought to be of considerable potential value to those who intend to study and improve these crops.

FAO has issued a circular letter describing the project to specialists for their preliminary comment and criticism. It is expected that a check list will soon be distributed to those who are in a position to co-operate in compiling the catalogue. FAO states that any comment or assistance in the project would be most welcome.

Hi-Ball Land Clearing in Western Australia

J. GRINDROD, B.A.(Com.)

In the issue of WORLD CROPS *for June 1951, a brief account was given of a new method of land clearing devised in America and called Hi-Ball land clearing. It was again referred to in an article on the same subject which appeared in our August issue, page 334. The method consists in towing a large heavy steel ball by chains attached to two tractors through land to be cleared. In our article it was suggested that the method might be of use in similar work in the U.K. It now appears that the method has been successfully adopted in Western Australia, and the following article briefly describes its application under these conditions.*

HOW to clear large tracts of tree-covered territory quickly and efficiently for subsequent cultivation has been a problem confronting the Land Settlement Board in Western Australia.

Although the old method of tree-pulling had been superseded by the standard method of clearing with the use of tractors, with various attachments added to give leverage so that the trees could be pushed down individually and later gathered into heaps for final disposal, this method was found to be too slow and was not giving the results desired by the board. To cope with the demand for farms it was decided that a new method must be found, especially as tractors could not be used in winter for the existing method, which involved backing and turning over the same tracks under load. At the same time it was the endeavour of the Land Settlement Board to combat increased costs, as far as possible, by mechanising the work of clearing to the limit so as to avoid hand labour in picking up after burning, mattock and axe work preparatory to cultivation, root picking, etc.

The Hi-Ball method

Having heard of the successful use of the steel ball for this purpose in America, the board agreed that, if practicable in Western Australia, the method would greatly assist in the rapid clearing of the timber and the ultimate development of farms. If successful it would also make possible the extension of clearing work into the winter months, since the heavy tractors would not be required to work several times over the same tracks.

Under the ' Hi-Ball ' system of clearing, heavy chains are attached to the axle of the ball and these ensure a leverage of at least 4 ft. at the point of impact with the tree, the chains being pulled by tractors. The weight of the ball, which is 5 to 6 tons, together with the weight of the chains, prevents the cable riding over small trees and ensures the smashing down and tearing off of limbs from fallen trees, thus leaving a good medium for subsequent successful firing.

Initial trials in Australia

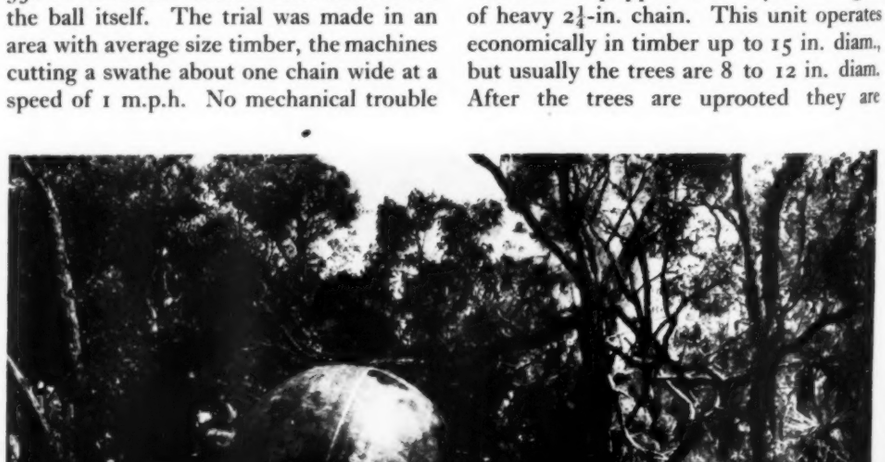
Initial experiments were carried out using two 7-ft. wheels from an old steam engine to provide the principles of the ball and two General Grant tanks as the tractive power. By such means it was demonstrated that this method of clearing could be used satisfactorily in Western Australia.

Following the successful use of the improvised equipment, arrangements were made with the Public Works Department to make a proper ball and other necessary equipment and a field trial was carried out in October 1951. This 8-ft. steel ball was coupled to two tractors. of approximately 110 h.p. each. There was approximately 350 ft. of cable between each tractor and the ball itself. The trial was made in an area with average size timber, the machines cutting a swathe about one chain wide at a speed of 1 m.p.h. No mechanical trouble was experienced and the ball and cable took all before it without any individual large trees being excluded.

Further developments

After this successful trial the board obtained approval for the manufacture of additional ' Hi-Balls,' which are being used in the Rocky Gully, Mount Many Peaks and Bokerup project areas.

Present units combine the use of two H.D.20 tractors, each of 165 h.p., and a ' Hi-Ball ' equipped with 240-ft. lengths of heavy 2¼-in. chain. This unit operates economically in timber up to 15 in. diam., but usually the trees are 8 to 12 in. diam. After the trees are uprooted they are



The ' Hi-Ball ' and 2¼-in. heavy chain smash their way through tree-covered territory which will be converted into farm land

pushed into windrows about 4 to 5 chains apart so that they may be destroyed by burning later in the summer.

Results

Results have proved very satisfactory and it has been found that each unit is capable of clearing from 70 to 140 acres per day, according to the type of country being worked. Heavier and deep-rooted trees and soils with clay nearer the surface decrease the daily acreage and increase costs.

Up to the time of writing about 50,000 acres had been cleared by this method at costs ranging from 20s. to 6s. per acre.

Swathes of uprooted and smashed trees left after the 'Hi-Ball' has been at work

The International Peat Conference

An international conference on the reclamation and reconditioning of peat lands was held in Dublin in July last. We have received the following account of some of the more important contributions to the conference from a correspondent.

HAND-WON peat has been a major factor in Irish economy as far back as recorded history reaches. Since 1934, however, when the forerunner of the present Bord na Mona was set up under Government auspices to develop the peat resources of the Republic of Ireland, considerable progress has been made *inter alia* in the survey, classification, reclamation and reconditioning of peat lands. The recent holding of an International Peat Symposium in Dublin was therefore appropriate.

Delegates attended from all Scandinavian countries, Iceland, Germany, the Netherlands, France, Scotland, Northern Ireland, England, Canada and the U.S.A. The U.S.S.R., the largest peat-owning and peat-using country in the world, was, however, not represented.

One of the early points made was the need for an International Peat Nomenclature and the setting up of a permanent body on the lines of an International Peat Institute was also urged.

Scottish peat survey

Mr. A. Tomter, a peat engineer in the Scottish Department of Agriculture, dealt in some detail with the survey methods used in his country. Field work is started at the end of March or April and finishes at the end of October or the beginning of November. Facts are collected and collated into four main classes. These are:

(1) The location of deposits.
(2) The area, depth and approximate volume of raw peat and solids.
(3) The content of moisture, ash and fibre, botanical origin, degree of humification, density, heat value and analysis of peat and ash.
(4) Suggested utilisation.

Irish sugar beet

Major-General J. M. Costello, of the Irish Sugar Co., gave details of how a 1,000-acre area of high bog, of about 20 ft. average depth, was acquired in 1951 and prepared for sugar beet growing. To offset drainage costs drains were cut by a light bagger machine to win peat fuel. Open drains were cut at 90-ft. intervals and mole drains cut at right angles to these. Each alternate field was used to dry the peat, the other field being cultivated. For several years it is proposed to sow grass, plough in the sod and repeat the process, using fertilisers as required. With mineral treatment, the bog was described as ready for beet growing. Trials have also been made with various grasses, clovers, cereals and manures.

By 1953, 340 acres had been drained and sown with grass. In 1954, a further 240 acres will have been sown. Grass is cut and dried and made into grass meal on the bog with peat cut from the bog drains used as fuel.

Somerset and Lancashire

Peatland agriculture in central Somerset and south Lancashire was described by Mr. J. Taylor, of the University College of Wales, Aberystwyth.

He stated that in both these areas extensive agricultural reclamation had been carried out, that the quality of the peat grasslands was poor and that much development on the lines of improved drainage, access roads and market handling was necessary. In Somerset, nearly all the peat is farmed peat and has been put in grass. In Lancashire, main crop potatoes form a major crop on peat soils, as do oats, but wheat is only grown on scattered areas. Another point he made was that the average Somerset moorland farmer of today would have difficulty in coping with any real intensification of the farming system. He expressed the opinion that it might be helpful to introduce educational facilities on the lines of the peatland societies of the Baltic countries as co-operation of the farmers themselves is certainly one of the secrets of the successful management of peat land.

Humus

A paper entitled 'A Fertiliser Industry Based on Peat' was presented by Krebs and Co., of Paris. Peat was described as the

Peat cutting in Connemara, Ireland. Much work of this kind is now done by machine

most important source of humus in the world. The divergency of opinion as to its value in agriculture was attributed to the use of peat which had been improperly treated, not treated at all or of unsuitable quality.

For a long time white peat had been used as a soil fertiliser and also as a base for the preparation of organic mineral composts. Experiments had been carried out to discover the fertilising value of brown peat, but these had not been very successful and research workers had found themselves forced to seek new methods of increasing its value. During the period following the second World War a process had been developed in Italy which had resulted in a product known as ' Flotal.' This was being used in increasing quantities for the improvement of heavy soil.

Meanwhile, other research workers had set themselves the task of restoring the humic value of organic matter in brown peat by a process of mineralisation. Since the end of the war an Austrian company and a French company had evolved processes of chemical treatment of suitable brown peat to produce a humic fertilising dressing. The products of these two companies were known as ' Humion ' and ' Humauby ' respectively.

German bog reclamation

A German delegate, Dr. W. Baden, of the State Bog Research Station, Bremen, described bog reclamation by excluding casual cultivation without permanent improvement, such as uneconomic development by burning the bog surface. Bog reclamation, he stated, could be regarded as commencing when casual cultivation is followed by the application of farmyard manure, or when the top layer of the bog is mixed with mineral soil in the cutaway. Both types of cultivation are still in use, the latter especially in the Netherlands.

Dr. Baden also expressed the opinion that the main point to be considered in assessing a type of bog for agricultural utilisation, especially in remote districts, is its natural lime and nutrients content. The significance of this point, however, decreases as fertilisers become more readily available and their prices and freights cheaper. He also stated that once a bog owner is supported by public money in his initial effort (cheap credit, subsidies) the economy of modern bog cultivation is beyond doubt. Points advanced in support of this view were that the maintenance of drainage is far less expensive than in fertile marsh districts, that the tilling of bog soils is less difficult than that of mineral soils and that once adequate drainage on the better type of bog is ensured in spring it offers little difficulty. The late frost risk could be minimised by adequate water control, cultivation and selection of crops.

He stated that crops on bog and sand admixture provided with well-balanced nutrients are scarcely inferior to those of mineral soils. Fruit and vegetables grown on bog, he stated, are particularly tasty and digestible, whilst feeding stuffs obtained from such cultivations are particularly nourishing.

Bog inventory in Norway

A director of the Norwegian Bog Association presented a short paper under the above title. His association, he stated, was a semi-public institution which depended upon private membership. It receives State support for investigations and research work in connection with the execution of plans for the utilisation of the bogs and peat resources of Norway.

They had carried out an inventory since 1934. Its object is to establish the exact location, area and possible uses of the individual Norwegian bogs, which are approximately 3 million hectares in extent. A little over 2 million of these are below the timberline, the remainder being above the timberline. The progress of the inventory has been slow in recent years, however, for financial and other reasons.

He claimed that his association filled a real need, as they constantly received enquiries from public and semi-public institutions, and also from private persons, for advice as to which bogs might be suitable for cultivation, pastures, peat moss or peat fuel purposes.

M. DUFFY

Photo : Fogra Failte

British Standards Yearbook

The yearbook of the British Standards Institution, which has been published recently, lists no fewer than 2,500 British Standards current at March 31, 1954 and gives a brief description of the subject matter of each. A comprehensive index simplifies reference. The usual information on the membership of the institution's general council, divisional councils and industry standards committees is given, together with the names of representatives on the main special committees and advisory committees. Particulars of the work in hand of all the industry standards committees are also given.

British Standards under which the institution's certification trade marks are used are listed beneath the following headings: Electrical; Building; Plastics; Bedding and Furniture; Personal Safety; Miscellaneous. Containing over 500 pages and attractively produced, the Yearbook is essential to all those whose work demands that they keep up to date with the increasing momentum of practical standardisation and simplification.

The Development of Spice Cultivation in India

IN a recent report to the Government of India the Indian Spices Inquiry Committee, set up in 1951 to examine the position regarding the production and marketing of black pepper, cardamom, ginger, turmeric, cashew nuts and lemongrass oil in India, has made a number of recommendations, especially in regard to pepper and cashew nuts.

Included in the recommendations are the creation of a separate central fund of Rs. 12.5 million for the development of the pepper and cashew nut industries under an integrated plan spread over 10 years, the setting up of three regional advisory committees for the development of these industries, the establishment of two special agencies in New York and London to promote sales, and the opening of additional research stations in producing areas to provide greater scientific aid for these industries.

Grown principally for export, these six crops are valuable foreign currency earners. Pepper and cashew nuts are particularly important exports, since a large proportion are shipped to America and are the supreme dollar-earning commodities of South India. Over the three years ended 1952-53 the average total value of exports of the six commodities amounted to Rs. 342.19 million, of which Rs. 207.81 million, or 60.7%, represented hard currency. Of this, dollar income pepper alone accounted for Rs. 131.26 million, the balance being earned mostly by the export of cashew kernels.

Among the districts visited by the Spices Inquiry Committee in the course of their investigations were Travancore-Cochin, Coorg and Mysore, Malabar and South Kanara.

Black pepper

One of the factors responsible for the reduction in world supplies of black pepper from 93,500 tons before the war to 43,500 tons, and its consequent increase in price, has been the loss of Indonesian crops. Nearly half the world production of black pepper is now grown in India and, of this, over the last three years, an average of 14,000 tons, valued at Rs. 271.7 million, has been exported, including exports to America valued at Rs. 131.3 million.

Cashew nuts

India is also the principal source of supply in the world market for cashew nuts, accounting for more than 95% of the international trade in this product. Indian grown cashew nuts, however, represent only rather more than one-half the total extracted nuts processed in and shipped from the processing factories which are concentrated in India. The other half are extracted from raw cashew nuts imported from East Africa. In spite of importing a large proportion of the raw material processed in the factories, the latter are still idle for two or three months each year for lack of the primary product and one of India's most urgent problems in this field is to develop and extend her own cropping programme. Both in Europe and America the demand for cashew nuts has been growing and the Committee considers the future prospects in this industry to be full of promise. An important by-product from the processing of cashew nuts is cashew nut oil, which is used as a preservative and waterproofing agent, while refined products of the oil also find a number of uses.*

Ginger

Of the remaining four commodities under review by the Spices Inquiry Committee commercial dry ginger is prepared in Travancore-Cochin and in Malabar. These regions supply an estimated 10,000 tons annually compared with 1,500 to 2,000 tons available from Sierra Leone and 1,000 to 1,500 tons from Jamaica. Because of the relatively higher price of Indian ginger and its larger fibre content, however, the demand for it is not so great as for the products of Sierra Leone and Jamaica, and the establishment of research stations in producing areas has been recommended by the committee for the purpose of improving the quality of Indian ginger and bringing down the cost of production.

Cardamoms,† turmeric and lemongrass oil

The possibilities for expansion of India's foreign trade in cardamoms, turmeric and lemongrass oil is considered to be limited. Of cardamoms India already grows more than sufficient to maintain her place as the principal source of supply, while out of the 120,000 tons of dry cured turmeric produced annually in India only about 10,000 tons are exported, the rest being used internally. In respect of lemongrass oil, of which, also, India is the largest world supplier, the export trade, which was built up considerably from only a few tons before the war, has shown some decline in the last year due partly to larger supplies being available from Guatemala and partly to a reduced demand from manufacturers of Ionone and synthetic vitamin-A in America and other countries.

The State of Assam has been selected as a possible suitable region for the growing of additional crops of black pepper and cashew nuts. Until recently, black pepper has been grown there on only a small scale in the Khasi and Jaintia Hills. Last year, however, both black pepper and cashew nuts were grown successfully on an experimental scale and plans are now being made for their more extensive cultivation.

* Reference may be made to an article on Cashew Nuts by Mr. A. E. Haarer which appears in our issue for March 1954, page 95.

† An article on Cardamoms appears on page 397.

English Pesticide Research Service Ended

The Fungicide and Insecticide Research Co-ordination Service, an inter-departmental service whose secretariat was accommodated at the offices of the Agricultural Research Council, has recently been dissolved and the following alternative arrangements made:

(1) The insecticides abstracts and news summaries will in future be issued from the office of the Colonial Products Laboratory, Imperial Institute Building, South Kensington, London, S.W.7, under the direction of Dr. R. A. E. Galley. They will be compiled with a view to meeting the needs of Colonial research workers, to whom distribution will for the time being be restricted.

(2) The analytical work formerly carried out at Woolwich will in future be done at Long Ashton Research Station, near Bristol, under the direction of Dr. J. T. Martin.

(3) The Insecticides Standing Conference, the inter-departmental body formerly responsible for co-ordination of work on insecticides and fungicides and for the Fungicide and Insecticide Research Co-ordination Service, is to be reconstituted as a smaller inter-departmental committee on insecticides and fungicides.

N.I.A.B. Annual General Meeting

THE annual general meeting of the Fellows of the National Institute of Agricultural Botany took place on Friday, July 16.

In presenting the report of the council, the chairman, Prof. T. J. Jenkin, O.B.E., referred to developments in the international field. During the past few months the institute had been approached by OEEC to co-ordinate two international projects. The first is concerned with a scheme for international grass strain trials. This will be undertaken in close co-operation with the Grassland Research Station at Hurley.

The second project is an attempt to obtain greater uniformity in the terminology used to designate the stages of herbage seed production. Each country at present has its own system and terms, such as 'certified' or 'elite' seed can mean quite different things in different countries.

The chairman also announced the decision of the Ministry of Agriculture that the N.I.A.B. should accept responsibility for the production of stock seed and for the certification of the Aberystwyth strains of grasses and clovers.

The Ministry's decision empowers the N.I.A.B. to accept responsibility for the certification of the 1955 seed crops of the Aberystwyth strains, and also approves the transfer of responsibility for the production of stock seed to the N.I.A.B. It will, however, be two or three years before the necessary facilities can be provided to enable the N.I.A.B. to undertake full responsibility.

Sir John Russell's address

Afterwards the meeting was addressed by Sir John Russell, O.B.E., D.Sc., F.R.S. Extracts from this address are given below:

The N.I.A.B. is doing a valuable job of work when it tests the actual performance of crop varieties before they are either widely used or rejected.

The need for the institute's work today is at least as great as ever it has been. British agriculture is now in a period of some uncertainty. Farmers have a general request to produce all they can. But, as against this, farmers are conscious of huge surpluses of wheat and other agricultural products piling up in the United States. There are, it is true, some analogies with 1921 and some anxiety is excusable. But I do not think there is any real reason to fear. In spite of the Iron Curtain—perhaps, indeed, because of it—there is far more international action than in the 1920s, and more readiness to spread local surpluses. For the fact remains that these surpluses are only local.

Food production

For the greater part of mankind food production has not kept pace with the increase in population. The rice-eating peoples, who constitute half or more of the world population, increased by more than 10% between pre-war days and 1950, but their production of rice actually decreased. The European and Mediterranean buyers of wheat are almost certain to increase their imports as their populations increase and their standard of living rises. Taking the long view, I see no reason to fear a continued over-production of wheat any more than I fear a coming shortage.

Some of our soils have been cultivated for 1,000 years, some even for double this period, yet they have suffered neither deterioration nor loss by soil erosion, and the yields of our crops have steadily increased and, so far as one can judge, are still steadily increasing. Our present average yield of 21.5 cwt. of wheat per acre is, of course, much exceeded by good farmers who would commonly expect 30 to 35 cwt. per acre, but these quantities look puny compared with yields of well over 3 tons in many of the institute's trials and that of 70 cwt. per acre obtained on a commercial farm in East Anglia quite recently. How are these big yields obtained? We do not know, but they show clearly enough that we are nowhere near nature's limits yet, and if we could only let in a little more light we could hope to get such further knowledge as would enable us considerably to increase our yields. That, of course, is the business of the scientific workers: some good teams are at work and if we leave them in peace to get on with the job we may reasonably hope for results, though no one can foretell when they may come.

The same foods cost more to produce here than they do in Denmark or Holland. One of our most urgent problems is to try reduce this cost of production. Here one can emphasise that the use of high quality seed and of improved varieties is one of the surest and least expensive ways of reducing costs of production.

The needs of Great Britain

No country of comparable size stands in need of so wide a range of crop varieties as Great Britain. You may start from the East Coast on soils that are only now being made and travel westward over a range of plains and hills representing older and older geological formations, reaching in the West Country and in Wales hills older than the Alps or the Rockies, but now worn down to mere shadows of their former selves. These different rocks carry different types of soil, sometimes related to the rocks, sometimes not.

Plant breeding has now become so highly developed that new varieties are constantly being produced, and there is always the chance that one of them may be better on a particular group of farms than any now in existence. We cannot afford to leave the chance untested. So the institute acts as the link that completes the chain joining the plant breeder, the seed distributor and the farmer.

I have had occasion to study the workings of this combination in a number of countries and I am impressed by its efficiency here. Beginning with the plant breeders, we have, of course, long been fortunate. We have long had among us artists in plant breeding—you can use no other word, for they were so obviously guided by intuition and a vision of perfection, for which they must always strive though they might never attain. So far as can be seen, the future of plant breeding is assured in this country. It is equally so in France, Holland, Sweden and Denmark.

Mr. Horne tells me that the institute has been asked by OEEC to undertake two important international enquiries: to prepare a classification of the various strains of grasses and to prepare a scheme for uniform nomenclature and terminology for seeds.

The search for improved varieties by plant breeding and selection and the search in the wild places by botanical exploration is going on in many lands and many interesting and potentially valuable sorts are being produced. But in many countries the work gets little further. New and almost certainly better strains of some of the crops have already been produced, but in the absence of a completely reliable seed trade the multiplication and distribution of the seed is very difficult. We rather take our seed trade for granted and would never doubt a guarantee of one of our great houses: it is difficult for us to realise how drastically this whole business of crop improvement would be hampered without it.

Problems for the plant breeder

There still remain problems for the plant breeder. We have got to face the fact that plant diseases and pests are likely to increase. Modern transport is so rapid that any pest or disease of any crop in any country is speedily carried to every other country where that crop is grown and if

conditions favour it, it soon becomes established. Further, we are busily upsetting nature's equilibrium in almost every direction. By far the best way of avoiding disease is to grow resistant varieties and here the institute is doing valuable work. Fortunately, resistant varieties are at times found wild, but by one of nature's little ironies resistance is often tied up with commercial uselessness, and it is for the plant breeder to untie the knot and carry the gene of resistance into commercially desirable varieties.

We may be sure that the numbers of new varieties and strains will continually increase and their range will widen, making more and more demands on the staff of the institute.

Land Reclamation in Poland

It is reported that far-reaching measures have been put in hand in Poland which have the aim of eliminating fallow land and of bringing into production meadow and pasture lands.

In 1945, nearly 20 million acres, or almost half of the country's arable land lay fallow or deserted because of the ravages of war. These have now been almost entirely reclaimed, but at the end of 1953 it was estimated that there were still about 1 million acres of fallow land and nearly 1 million acres of virgin soil and of under-cultivated land.

The question of meadow improvement is particularly important as an adjunct to increased stock-breeding. Meadows and pastures occupy over 10 million acres or over 20% of Poland's farm land, so the potentialities are considerable. Up to last year some 1,250,000 acres of meadow land had been reclaimed and drained. Rather less than 625,000 acres of reclaimed meadows were ploughed and sown with high-quality grass in this same period.

Of recent months over 475,000 acres of fallow and other uncultivated land were earmarked for reclamation. Drainage and irrigation works were restored in over 250,000 acres of meadow land and general maintenance work was put in on a further 290,000 acres.

This reclamation work is regarded as a preliminary step to be followed by further work on a much larger scale.

Major responsibility falls to the State farms, which will deal with large compact areas of fallow land. It is envisaged that this year they will be able to sow at least 40,000 hectares with winter crops. To assist them more mechanical aids will be made available and farm workers taking part in these schemes will receive bonuses.

Avocado Culture in South Africa

From a Correspondent

THE avocado pear (*Persea gratissima*) is a sub-tropical fruit which is rapidly gaining in popularity both in South Africa and in England, where trial shipments have been successfully marketed through Covent Garden. The fruit consists of an edible pulp surrounding a large hard seed. The pulp, which is of a greenish hue, is rich in oil and the avocado pear ranks next to the olive in the oil content of its flesh. Some varieties of the fruit weigh up to a pound or more and the edible portion consists of about 75% of the total weight, the remainder being the inedible skin and seed.

Industrial uses

Farmers in the Union are watching closely the attempts which are being made to find industrial uses for surplus and cull fruits. Food processors are interested in the use of avocado flesh for making sandwich spreads, salad dressings and similar preparations.[1] A small plant with a capacity reported as 600 tons of fruit annually was recently started in the Johannesburg area for extracting avocado oil. Yields of up to 16% (based on the weight of the whole fruit) of a green-tinted oil can be obtained from certain varieties. This oil is valued in the soap and cosmetic industries for its beneficial effects on the skin.[2] The high prices (up to £1,000 per ton) fetched by this oil in recent years have encouraged farmers to plant the oil-rich varieties, such as Fuerte, which was successfully developed in California by crossing Mexican and Guatemalan fruits. Marloth has reported in detail on the results obtained in South Africa from plantings of different avocadoes, including both early, middle and late seasonal strains, such as the Ward, Fuerte, Mayopan and Itzamma varieties.[3]

Cultivation areas

The avocado tree has been found to flourish in general wherever citrus fruit is grown and so the main avocado-growing areas of the Union occur in the warmer regions of the Eastern Transvaal and neighbouring Swaziland. The fruit also grows well in parts of Natal, but, although the edible quality is satisfactory, the oil yield is said to be disappointing and it appears that both climate and soil can greatly influence the nature of the pulp. The 1949-50 agricultural census revealed that there are approximately 250,000 avocado trees in the Union and with recent plantings it is expected that this figure has already been increased by at least 20%. If an average yield of 100 lb. of fruit per tree per annum is assumed, production of avocadoes in a good season is already over 12,000 tons. The avocado tree grows to a height of 35 ft. or more and several thousand trees can be found on single farms. Further details of avocado cultivation under South African conditions were published by Le Roux.[4] In general, the experience of Californian fruit growers has been utilised to find the best manner of handling the fruit crop, as the U.S.A. is probably the only major avocado producer where the pear is specially grown for its oil content (the Californian production of avocadoes was reported as nearly 50,000 tons in 1952).

Oil extraction

Conventional pressing methods used for olives have not been very successful with the avocado because of the high moisture and lower oil content. However, several processes have been developed which give adequate yields while ensuring that the vitamin content of the flesh is not destroyed.[5] The average oil yield from an acre of trees is low compared with that of other vegetable oil-producing crops and a typical figure would be about 48 gal. of oil per acre. The seed of the avocado, which may occupy up to 20% of the whole fruit, does not contain any appreciable quantity of oil, neither is it of any great value as an ingredient of animal feeds.

Ripening

Experience has shown that it is important to allow the fruit to ripen on the tree to the maximum extent possible, as the oil content of the flesh increases with maturity and when the fruit is picked for oil extraction it can be safely left on the tree until riper than when harvesting for sale as fresh edible fruit. However, the mushy nature of the ripe pulp presents certain problems when extracting oil by pressure and it is important to prevent undue oxidation, which causes darkening of and spoiling of the pale green colour of the fresh oil. From both the industrial and edible angles, the demand for South African avocadoes is likely to increase further in the near future and farmers expect that their present crops will prove economic under the conditions likely to prevail in the Union in the coming years.

REFERENCES

1. *Food Industries of South Africa*, p. 37 (Nov. 1953).
2. *Seifen-O.-F.W.*, **79**, 1, 14 (1953).
3. *J. Dept. Comm. Ind.* (Dec. 1942).
4. Department of Agriculture Pamphlet 217, 'Avocado in South Africa.'
5. *Bull. Imp. Inst.*, **34**, 4, 480.

CORRESPONDENCE

Systemic Insecticides

TO THE EDITOR

Dear Sir,

May I comment on Dr. Holmes's letter in the September issue of WORLD CROPS, where he outlines his own experiences with certain systemic insecticides on hops, which differ markedly from my own.

My communication described the results of work carried out in 1953 and these, in large measure, confirmed the results of field trials with demeton (in the form of ' Systox ') and schradan (in the form of 'Sytam') in Belgium in 1951 and 1952 and of many commercial trials in England in 1953.

With Dr. Holmes, I regard demeton as an extremely good systemic insecticide for certain purposes, particularly the control of red spider, where its efficiency is slightly greater than that of schradan. This is particularly the case with apple trees, where the more localised action presumably reduces the dispersal of the insecticide into the wood.

Zattler's trials in 1950 were primarily against red spider; aphis infestation was too low for satisfactory assessment of value against this pest. It is known that, when only a mild infestation is present, an initial elimination gives prolonged freedom from pests in a commercial crop. This was clearly shown in one site of our 1953 trials. When infestation is heavy initial knock-down will not ensure adequate control. It is only then that the true residual effect of the insecticide can be judged.

In the case of hops, the residual effect of demeton, used at 0.05% of the commercial preparation, was found by us to last 14 to 16 days. A similar figure has been published by H. Geffers and by G. Unterstenhofer. My conclusions were not challenged by Unterstenhofer at the Ghent Symposium in May of this year, when I described the work under discussion.

Despite the findings of Zattler that a concentration as low as 0.01% of the 50% demeton preparation could be effective, the makers' recommendation for hops is 0.05%. Their experience is apparently similar to ours in 1953, that, while the low concentration will give an initial kill, it is inadequate to ensure the necessary residual action. In the same way we have used schradan preparations at concentrations of 0.02% and under favourable conditions have obtained perfectly satisfactory control. Under unfavourable conditions, however, the use of so low a concentration would, in our view, lead to extremely poor control.

Contrary to Zattler's statements in *Höfchen Briefe*, we agree with Dr. Holmes in considering demeton more effective on hops by soil application than by spraying. We also find that, in a dry soil, the application of a large volume of dilute solution results in complete failure, whereas a small volume of high concentration gives perfect control.

I cannot, however, accept Dr. Holmes's view that in demeton the hop grower has an aphicide and acaricide of unsurpassed potency and efficiency. We have compared it with dimefox (' Terra Sytam ') under identical conditions of concentration and find it about half as efficient as the dimefox preparation, judged by the quantity required to give 100% protection for a given period.

Cases have been brought to our notice where demeton has failed, presumably due to soil conditions. In some instances a second application has been tried without avail. One such failure occurred in our own current field trials. No similar anomaly has been encountered with dimefox.

Yours faithfully,

G. A. EMERY.

The Murphy Chemical Ltd., Co.
Wheathampstead, St. Albans, Herts.
August 10, 1954.

Note.—We regret that there was a misprint in Dr. Holmes's letter which appeared on page 386 *of our September issue. In the 5th line from the end of the second paragraph, the word ' necessary ' should read ' unnecessary.'*

Mechanical Clearing

TO THE EDITOR

Dear Sir,

I was greatly interested in the article on the mechanical clearing of forest and scrub land which appeared in your August issue, and the short note on the same subject in your issue for September. As the contractor responsible for the clearing work on Mr. Hill's estate at Crux Easton, may I offer the following comments.

Getting rid of the mass of roots is, in my opinion, a major problem of this type of work inasmuch as it is almost impossible to rake out the roots unless one is lucky enough to have very dry conditions when carrying out the final cultivation and raking. Most contractors work on the principle of a heavy plough and burying the trash, but this has the disadvantage of sometimes bringing up so much bottom soil as to prevent the plough dealing with any solid obstructions it may meet.

In discussing the economics of this work in the United Kingdom you give an example which, I take it, is a quote of the N.A.A.S. I think that these figures are rather misleading inasmuch as the amount of the grant made by various County Agricultural Executive Committees varies so much; the example given by the N.A.A.S gets a total grant of £35 per acre, while in Hampshire the maximum grant is £25 per acre, but in Wiltshire they will give up to half the cost. It seems to me that it would be interesting to bring this subject up on a Government level so that there could be some uniformity from county to county.

Another point brought out in this article is why has no British contractor used the chain and ball method of clearing? There are two reasons, in my opinion, why this is not a practice in England: firstly, there are very few schemes which are sufficiently large to make the employment of this method an economic proposition; it would be necessary to have a number of tractors on the site at the same time, while the transport costs of the chain and balls would, I imagine, be very expensive. Secondly, I do not think it would work practically with the type of vegetation in our scrub land. I have always thought that the root system produced by scrub here is considerably tougher and more matted than that growing in such places as Tanganyika. My own opinion is that if one used the ball and chain method in England one would do no more than flatten the overgrowth, perhaps even breaking it off by its roots without removing the roots out of the ground. I appreciate, however, that the root rake on the front of my machine is probably pushing the trees over at a greater height from the ground than would be the case of the ball and chain method.

I was deeply interested in your article and have made the above observations with the hope that my experiences may be of some value.

Yours faithfully,

H. R. NUDING.

1 Arnewood Court,
Sway, Lymington, Hants.

Technical News

The October issue of *Manufacturing Chemist* includes ' Technology in the Fine Chemicals Industry—3: Processes Involving Special Hazards,' by T. Dewing, and the ' Quinoline Drugs,' by S. Collett.

Petroleum for October contains ' Photography in Oil Research,' by A. J. Insall and J. W. Drinkwater; ' Gamma-Radiography in Oil Storage Installations—3,' by C. C. Bates; and ' Geophysical Methods of Oil Prospecting—1,' by D. Taylor Smith.

Among the articles in *Paint Manufacture* for October are ' Newspaper Inks,' by A. H. Soane; ' Paint Deterioration,' by F. Pupil; and ' Emulsion of Polymeric Materials,' by J. O. Cutter.

NEW BOOKS

East Malling Research Station Annual Report for 1953

East Malling Research Station, Maidstone, Kent. Pp. 232, illustrated. 1954. 12s. 6d. (U.S.A. $2.00).

This report consists of four parts, the first outlining treatments given to the plantations connected with the station, and summarising information concerning crops harvested. Part 2 reviews research work, lists papers published during the year and records progress made in the study of the varied problems confronting fruit growers. Part 3 is devoted to research reports and reviews; it also includes the text of the sixth Amos Memorial Lecture by Prof. R. H. Stoughton on 'Some Aspects of Growth and Development in the Fruit Plant.' The 24 papers in Part 3 cover a wide range of subjects connected with pomology, plant physiology, plant pathology, entomology, plant protective chemistry and statistics. Part 4 consists of the following 10 bulletins intended to present some practical aspects of research at the station: herbicides in fruit growing, a description of the experimental plantations at the station, regulated pruning, bacterial canker, wilt-tolerant hops, low-volume concentrate spraying, the recognition of various top fruit aphids, predacious insects, strawberry management, and a survey of the origin and work of the research station since its inception.

The report observes an even balance between fundamental research and its practical application. The more important investigations appear to have been concerned with the apple, but raspberries, strawberries, hops, cherries and plums are also the subjects for special articles, in addition to which noteworthy articles concern research on bacterial, fungal and virus diseases, insect pests and the influence of weather conditions on fruit.

Research on fruit is usually considered as long-term work by reason of the time lapse between planting and fruition. It is, therefore, astounding to realise that the noteworthy contributions of the station have taken place within the last 40 years. This success has been achieved mainly by a clear concept from the beginning of the scope of investigations to be undertaken, logical development made possible by wise direction and a brilliant staff and, not least, the co-operation of fruit growers and the nursery trade. This close link with the trade has been fostered throughout the history of the station and, at the same time, has been maintained with scientists both at home and abroad.

East Malling has become widely known as a result of its valuable work on the collection and classification of fruit tree stocks and the production of improved stocks. Success in this direction has led to the adoption of practical measures to overcome certain types of incompatibility at the union of stock and scion and to a detailed study of the root system from different soil types and under various systems of management.

Experiments in pruning have shown the importance of suiting the treatment to the variety, tree vigour and purpose. Pruning trials have also been designed to produce trees of different cropping performance suitable for studies on the control of biennial bearing and the effect of this form of pruning on early cropping.

Cultural problems of fruit growing

The main cultural problems of the grower are usually connected with soil management. Following valuable manurial experiments and studies of root growth distribution, the station is now investigating the effect of cover cropping and other cultural treatments upon soil structure and fertility, also upon the mineral and water relations of the tree. In collaboration with the Ditton laboratory of the Department of Scientific and Industrial Research, an investigation on the effects of soil management and other field factors on the storage life and quality of apples is being developed.

Fruit damage and resistance to frost have been studied for some years, methods of protection have been considered, and a long-term programme started with the object of raising late-blossoming apple varieties of good market quality.

Varietal trials, now undertaken by the national fruit trials, include a number of varieties bred at East Malling, the best known of which are the Malling raspberries that now form a high percentage of commercial raspberry acreage, apple varieties of Worcester Pearmain and Cox's Orange Pippin, and the black currant Wellington XXX.

The central theme of the research programme from the beginning has been the study of the fruit plant and the biological and physical factors affecting cultivation under orchard conditions. The work is primarily designed to be of value to the commercial grower, but much of it is of equal value to the amateur fruit grower. The present well illustrated report, which merits careful reading, is therefore assured of a wide appeal.

D. H. GRIST

Let There be Bread

By Robert Brittain, with a foreword by Lord Boyd Orr. Pp. xi + 263. London. Spalding and Levy. 1953. 12s. 6d.

This book can be regarded as yet one more effort—and a particularly vigorous and trenchant one, it must be admitted—to lay the ghost of the Rev. Thomas Robert Malthus, author of the celebrated essay on population at the end of the 18th century. Nevertheless, this tough old spectre continues to walk abroad, notwithstanding that on many previous occasions as well as on this it has been triumphantly proclaimed that henceforth it can be safely relegated to the limbo of forgotten bogeys.

On this occasion the author, who is, we gather, a professor in an American university, has reviewed the resources of the world, exploited and undeveloped, which can be utilised for the production of food for the human race, and the new methods of utilising them which are now being developed in ever-increasing profusion; he comes to the conclusion that, if full use is made of them, the world need no longer fear the prospect of eventually eating itself to extinction if population increase is not restrained or effectively checked.

It must be admitted that the author has made out a strong case, well documented by examples of achievements and revealed possibilities in many countries, and ably presented in forceful and picturesque language; he, in fact, possesses in a marked degree that capacity for telling exposition which is so striking a characteristic of American publicists. In his foreword Lord Boyd Orr takes a somewhat less optimistic view than does the author. He asks the question, 'Can the earth support 4,000 million people?' and concludes that with the aid of modern science it can be done. On the evidence one may agree that it most probably can, but the question arises, 'What then?' Will not that pertinacious ghost once more raise its undiminished head?

Whatever may be one's view of the ultimate issue, it must be acknowledged that the author has produced a book which should be studied by all, if only for the arresting exposition of modern progress in development which it contains.

H.T.

Mango Cultivation

By L. B. Thrower. Sudan Government, Ministry of Agriculture Bulletin No. 11.

This is a study of the mango tree in the Sudan. It appears that the plant was introduced to the Sudan from Egypt and originally came from India. The introduction and development of mango trees in the Sudan dates mainly from the early years of the

present century. Originally the tree did not spread far from roads and settlements, but now it has spread to many localities where conditions are such that it is possible for the plant to be grown. Under most conditions in the Sudan the trees can only be grown under irrigation, but in Equatoria it can be grown under natural rainfall.

The Feeding of Farm Livestock

By J. C. B. Ellis, M.A. Pp. xv + 267, illustrated. London. Crosby Lockwood. 1954. 21s.

This is the third edition of a book which has now become accepted as a standard work on the feeding of livestock. It is prefaced by a foreword by Sir James Scott Watson, who points out that almost three-quarters of the income of British farmers is derived from livestock products and that it follows that efficiency and economy in the use of feeding stuffs is of high importance in relation to farmers' costs and profits.

The book itself was written with the object of explaining how rations for farm livestock may be computed by using the starch equivalent of Kellner and the protein equivalent as standards of energy and protein. The early chapters are devoted to an explanation of the derivation and meaning of these feeding standards, followed by a chapter illustrating their use in drawing up rations for various purposes. In subsequent chapters the various components of rations are described under various headings, including pasture grass, hay, dry fodder, roots, green crops and concentrated feeding stuffs, while the later chapters in the book are devoted to the feeding of various classes of livestock, including cattle, dairy stock, calves, sheep, pigs and poultry, and giving useful details on the housing of various types of animals, while the effects of various types of feeding are illustrated by photos, *e.g.* of sides of bacon.

The book can be commended as an excellent guide to farmers on this important subject. It is well printed and got up, while the illustrations comprise excellent reproductions of photographs and line drawings. An appendix gives the composition and nutritive value of feeding stuffs used in Great Britain.

The Statistical Yearbook of the Food and Agriculture Organisation

This is the seventh issue of the year book of food and agricultural statistics published annually by FAO. In addition to the first complete lists of production figures for 1952 and the latest revision for pre-war averages, the book contains post-war averages prepared on the latest revisions of data for the years 1948-50. The publication of the yearbook has been made possible by the co-operation of governments who have supplied most of the information from annual questionnaires. The yearbook attempts to preserve continuity with the previous volumes, while at the same time improving the coverage, quality and usefulness of the statistics presented.

As the only record of world agricultural production, the volume, like its precessors, is of the greatest value.

Grain Crops

A summary compiled by the Intelligence Branch of the Commonwealth Economic Committee. Pp. xx + 134. London. H.M.S.O. 5s.

The annual reviews of various commodities prepared by the Commonwealth Economic Committee are now firmly established and recognised as reliable sources of information. The present publication on grain crops is another member of the series and, as usual, contains a valuable summary of information on the production of cereals throughout the world. It appears from the report that world production in 1952-53 expanded considerably. The greatest part of the increase was due to wheat, maize, rice and barley, which were above the pre-war average. Export of grain in 1952, however, showed a slight decline, the volume of grain entering world trade being less than 10% greater than before the war.

Stocks of wheat accumulated in U.S.A. as a result of larger shipments from Canada. During the year export prices, except in the case of rice, showed the reverse of the trend in previous years and declined somewhat. Maize and oats have shown little change. The volume of exports in wheat have been maintained at a high level, but the downward trend of grain prices became apparent, while even quotations for rice began to fall.

Like its predecessors, the volume may be commended unreservedly to all interested in the statistics and economics of grain production.

American Tomato Yearbook

Edited by John W. Carncross. New Jersey. C. J. Macfarland. $2.

The 1954 edition of the American Tomato Yearbook is again edited by Dr. John W. Carncross, Rutgers University College of Agriculture, and contains much interesting and vital information for all those with an interest in the tomato industry in the United States. Of special significance is the complete and up-to-date list of recent references to tomato culture, tomato diseases, pests and their control. Leading features are the names and addresses of men and women engaged in tomato research in the United States and a classified directory of business concerns serving the tomato field.

The book is profusely illustrated with up-to-date charts, graphs and pictures. In addition, there is much valuable statistical information. This includes data on tomato yields, acreages and production for both processing and fresh market, statistics on tomato products, imports and exports.

Making Known

Mr. W. Leonard Hill, chairman of Leonard Hill Ltd., publishers of WORLD CROPS, has accepted an invitation from the City of Liverpool Public Libraries Committee to deliver his address 'Making Known' at the Central Public Libraries, William Brown Street, Liverpool, on Wednesday, October 13, at 7.30 p.m. Mr. Hill originally gave the address in his capacity as chairman of the Agriculture Group of the Society of Chemical Industry at the annual general meeting, Burlington House, London, on May 18. The lecture at Liverpool will be the first of a number of technical information lectures to be given during the 1954-55 session and it is being arranged in collaboration with the Association of Special Libraries and Information Bureaux (A.S.L.I.B.).

Mr. W. Leonard Hill

Other lectures in this series will deal with the subjects of welding (November 10), British standards in production engineering (December 8), packaging (January 12), detergents (February 9) and high-voltage engineering (March 9).

REPORTS AND PUBLICATIONS

The First Annual Report of the West African Institute for Oil Palm Research.

We recorded the formation of this institute on its present lines in WORLD CROPS some months ago. Actually the organisation out of which the Oil Palm Research Station has grown was started in Nigeria as part of the Department of Agriculture of that country as long ago as 1939. It has evolved into a West African Research Institute for all four West African colonies since April 1952.

The institute is governed by a governing committee which includes a representative of each of the four West African territories. The director of the institute is Mr. F. W. Toovey, who is well known as an authority on the West African palm oil.

The station is administered by the director, assisted by a deputy director, an accountant, an executive secretary, a plantation manager and a station superintendent; the research staff comprises agronomists, chemists, geneticists, plant pathologists, plant physiologists and a statistician, giving a total of 27 approved senior posts and a staff of 134, including agricultural assistants, laboratory assistants and other junior officers. Seventeen senior posts have been filled and 80 junior posts.

The principal station is situated near Benin City. The total area of land available for the station is apparently approximately 4,300 acres. Of this about one-third is being utilised at present, the remainder being reserved for future expansion. Actually about 1,000 acres have been planted in oil palms. A substation of about 450 acres has also been established near Abak in the Calabar Province in the Eastern Region. The station is still in the partly developed condition and a considerable amount of constructional work remains to be done before it is complete.

So far the buildings constructed include an administration block, laboratories for chemistry, plant pathology and physiology, with a number of ancillary and farm buildings, while quarters have also been constructed to house the senior and junior staff. It is clear that the institute now has a claim to rate as one of the major research institutes in the tropics.

The report contains an account of the main lines of research at present in progress. An important section deals with the raising and planting out of oil palm seedlings, including the raising of new varieties and the treatment of plantations which have been established. This has included trials with inter-cropping and manuring as well as with leguminous and non-leguminous cover crops. Since the station has been in existence for a number of years, some of the results afford clear indications; thus the advantages of continued inter-cropping and manuring have been clearly demonstrated, while the harmful effects of neglect are shown.

In regard to manuring, perhaps the most striking result is the response that has been shown to applications of potassium.

A great deal of work has been carried out in regard to diseases and pests of the oil palm and a large number of diseases are described and recorded as fairly common. Leaf symptoms are regarded as falling into three groups: (1) yellowings, (2) orange spottings and (3) chloroses. Results to date indicate that orange frond disease may be due to magnesium deficiencies. The fungal diseases examined include little-leaf disease and basal decay.

It is not possible to discuss in further detail here the various results, but it is obvious that the station is carrying on work of considerable importance which should be of increasing value to the oil palm industry of West Africa, as it evolves from its original status of dependence on the haphazard extraction of oil from naturally occurring wild palms to that of an industry relying on the produce of properly established and cultivated plantations.

The report itself is well produced.

Annual Report of the Imperial College of Tropical Agriculture, 1952-53

The Imperial College of Tropical Agriculture underwent a series of changes during 1953 in its higher personnel. Sir Raymond Priestley resigned as chairman of the governing body in 1953 and was succeeded by Sir Frank Engledow, F.R.S., who was from 1929 until 1949 representative of the University of Cambridge. Mr. H. J. Page, C.M.G., O.B.E., retired from the office of principal in 1952 to take up work with FAO. He was succeeded by Dr. G. A. C. Herklots.

During the year the new Frank Stockdale laboratories and the Francis Watts laboratories for chemistry were officially opened and the college also celebrated the silver jubilee of its charter. The college had a record number of students during the year and for the first time post-graduates outnumbered undergraduates. The scheme for the training of members of the Colonial Agricultural Service, which includes one year at the college, has continued to give satisfactory results. Of the probationers who left the college during the year, seven were destined for Malaya, seven for East Africa, nine for West Africa and one each for Aden, Northern Rhodesia and the West Indies.

The agricultural department of the college had a relatively settled year following a period of staff changes and it was possible to arrange a programme of lectures and field investigations based on a long-term policy. The course in agricultural engineering has been revised, as have also the courses in horticulture and animal husbandry. It is satisfactory that at last the college has ample land available for its research activities. A feature of the training is that each post-graduate is required to undertake a definite research project, on which he spends a fair proportion of his time and finally presents a report which must be approved by the examiners if he is to be awarded a diploma in tropical agriculture.

For the third year an agricultural show was held at the college farm with the co-operation of the college and local firms. The subject was all types of agricultural tractors and machinery.

It is obvious that the work of the college continues to be satisfactorily carried on and its value as a training institute for members of the Colonial Agricultural Service cannot be over-estimated.

Colonial Development Corporation Report and Accounts, 1953

We have received a copy of the report and accounts of the Colonial Development Corp. for 1953. During the year five new projects were undertaken, seven were abandoned, two were completed or disposed of and three investigations terminated. Some old projects have been merged or divided to conform with operational developments; there are now 50 projects in progress. Capital sanctioned for production increased from £39,400,000 in 1952 to £43,512,000 in 1953. The capital actually employed was £25,349,000, compared with £22,885,000 last year. Projects dealing with agriculture, animal products, forestry and minerals accounted for 56% of the total.

Of the agricultural undertakings, among the largest is a loan to finance the expansion of rice production in British Guiana and a scheme to develop timber extraction in the same colony. The schemes for the production of ramie in British Honduras and Kenya have been discontinued, as have also the farm development scheme at Castle Bruce Estate in Dominica; the corporation has also withdrawn from the large-scale Niger agricultural project, which was formed in 1949 to clear a large area in the Niger province for experiments in mechanised cultivation and land settlement on a

share cropping basis. It is now left to the National Administration of Nigeria to decide whether to continue the experiments. The project has resulted in a net loss to the corporation of £10,000; it is stated that the chief reasons for these losses were poor harvests, unsatisfactory work by workers and unusual technical problems. It seems somewhat unfortunate that this project, which in principle appeared highly promising, should be abandoned after so short an experience and before the practicability or otherwise of the premises on which it was based had been established.

Various other projects are continuing, including the Vipya Tung estate and the Kasungu tobacco estate in Nyasaland, although the prospects of these do not appear very bright. The Malayan cocoa estate and Borneo Abaca Ltd. both continue to be operated in conjunction with commercial firms and the prospects seem fairly good.

The agricultural achievements of the corporation so far do not, it must be admitted, appear to be very impressive and the conclusion cannot be avoided that schemes of this description may probably be undertaken with the best prospects of success if they are launched in collaboration with commercial firms of good standing whose experience may be relied upon to restrain the embarkation of British taxpayers' money on speciously attractive schemes and who may be able to provide a reliable idea of the length of time required to test schemes and so obviate the abandonment of projects before they have had time to demonstrate their value.

The Quarterly Journal of the Royal Agricultural Society of Kenya

We have received copies of the first and second numbers of the quarterly journal of the Royal Agricultural Society of Kenya. It apparently represents the fulfilment of a long-cherished ambition of the society to produce their own journal on the lines of that of the Royal Agricultural Society of England. These first numbers contain particulars of the society's activities, which continue to expand; as well as articles on 'Milk Recording in East Africa,' 'Producduction of Home Grown Stock Feed in Kenya' and 'Grass Species for Leys in Medium Altitude Areas,' there is a progress report on grassland research by Mr. C. C. Webster, together with notes on matters of interest to local farmers and correspondence. The first issue is prefaced by a portrait of the late Alex Holm, C.M.G., C.B.E., who was president of the society from 1920 to 1932 and director of agriculture in Kenya during the same period. There is also a foreword by Mr. F. W. Cavendish-Bentinck, the member for agriculture and natural resources in Kenya, in which he welcomes the appearance of the journal and wishes it success. We take this opportunity of offering our own good wishes to the journal, for which there appears to be abundant scope.

Annual Report of the Research Division of the Sudan Government Ministry of Agriculture, 1949-50

We have received a somewhat belated copy of this report, which gives interesting details of the work of this organisation for the season 1949-50. Of all Departments of Agriculture in British and non-British tropical territories overseas, few, if any, can compare with that of the Sudan in the size of its research division and in the variety and excellence of the work it has conducted. Indeed, the work of the Sudan department constitutes an example and pattern of what the work of such sections should be.

The report itself contains interesting details of the work of the cotton breeding sections in the Gezira and at Shambat. This is now well known throughout the world and the success which has been achieved in developing the technique of the transference of particular characteristics is striking. The production of varieties of sakel and other types of cotton which are resistant to black arm disease are striking achievements, while great interest also attaches to the work described in the report of breeding varieties of cotton resistant to jassid.

The work of the soils division under Dr. T. N. Jewitt also merits special mention and the progress of the reconnaissance soil survey in the Blue Nile Province and in Equatoria is definitely encouraging. Other important work of this division relates to studies of the carbon-nitrogen ratio of the Gezira soils. The report also contains interesting accounts of entomological, mycological and agronomical work, including work on fruit crops.

It is hoped that the governmental changes which have occurred in the Sudan will not result in any falling off in the high standards of work of the research branch.

Progress Reports of the Experiment Stations of the Empire Cotton Growing Corporation

We have received copies of the progress reports of the experiment stations of the Empire Cotton Growing Corp. in various parts of the world. The most important of these deals with work at the Cotton Research Station at Namulonge, Uganda, which has just completed its third year of work. During the year 1952-53 the station was enlarged considerably by the inclusion of 32 acres of new land, mostly on a slope of 6°. It has been possible to include these rather steep sloping lands because of the improved success of tieridging as an anti-erosion measure.

Mechanisation of the farm has continued to be a question of adaptation and invention. It was found that the Massey-Harris '433' maize and cotton planter required some modification before it could be used with the Fordson Major at the station.

The herd of cattle was supplemented by additional cows and heifers. The season 1952 was much drier than the two preceding ones. It was expected that cotton areas would reflect the major deficiencies in rainfall, but the June sowing levels were not very different from previous annual totals.

The work of the station deals not only with cotton, but also with other crops which can be grown in association with it. Work on soil chemistry has not yet become fully established owing to lack of staff and equipment. In regard to plant physiology, studies have continued on the development of the cotton plant and on the production of buds and on bud shedding. The section on this is illustrated in a series of graphs.

Plant breeding included efforts to produce varieties resistant to bacterial blight and verticillium wilt. It also included breeding work on the variety BP52, which at present is widely cultivated in Uganda. Obviously the research station has now got into its stride and is doing valuable work.

Other progress reports include those on work in the West Indies, Southern Rhodesia, Nigeria, Kenya, Tanganyika and Aden. It is impossible to deal with them in detail, but together they give an account of the valuable work for the cotton industry in the British Commonwealth which is being carried out by the research workers of the Empire Cotton Growing Corp. in many environments.

To Authors and Readers

The publishers of WORLD CROPS invite the submission of manuscripts of books to be considered for publication. All manuscripts will be promptly acknowledged and carefully considered by qualified experts. A synopsis with chapter headings should be sent in the first instance, addressed to the Book Production Manager.

The publishers are specialists in industrial, technical and scientific books, and have a world-wide selling and distributing organisation.

FARM MACHINERY

Machinery Day at Fernhurst

FOR some years past it has been the practice of Plant Protection Ltd. to hold at their research station at Fernhurst, machinery days, at which demonstrations are given, with the collaboration of manufacturers of spraying and dusting machinery, of the performance of the latest types available of these machines. These demonstrations have in the past been much appreciated, not only by British farmers, but also by visitors from overseas, because they afford an opportunity of comparing in operation a wider range of machinery than can normally be seen under practical conditions, and in organising them Plant Protection have rendered a valuable service.

The third demonstration of this kind was held on July 29 at Fernhurst under weather conditions which, as the event turned out, were markedly better than the forecast gave ground for hoping; there was, in fact, a welcome absence of the 'occasional showers' which British people have come to regard as the normal condition in this very wet summer.

The demonstration was attended by a large number of people, about 1,000 being present. It opened at 10.30 a.m., and from 11 a.m. onward guests were given the opportunity of making tours of the Fernhurst property and of seeing the numerous lines of experimental work and investigation in progress. Spraying machinery manufacturers had been given facilities for exhibiting their range of machinery on the demonstration ground and throughout the day visitors were able to inspect and try out machines for themselves if they so desired.

The actual demonstration of the machinery in action commenced at 2.15 p.m., when all the participating exhibitors displayed their principal machines in the large arena which had been roped off for the purpose. In all some 24 firms participated.

Since the first display of this kind was held at Fernhurst in 1949 the popularity of spraying for the control of the insect and fungoid enemies of crops and for the control of weeds has increased enormously. In particular, low-volume spraying has made considerable strides and has developed greatly. Today, it is estimated that there are at least 20,000 low-volume sprayers in the United Kingdom alone, compared with a few hundreds in 1949.

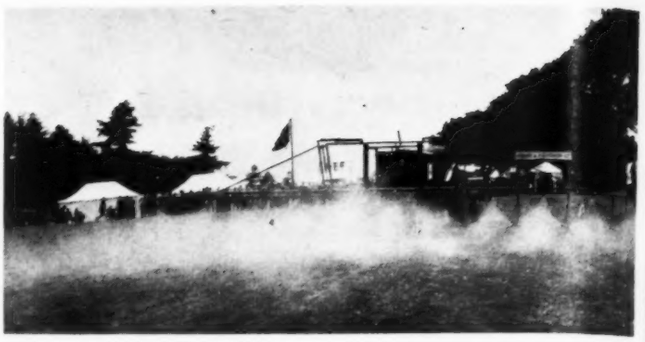
Range of machinery shown

The range of machinery shown ranged from large fruit and hop atomisers with tank capacities of up to 500 gal. down to small hand type of atomisers intended for garden use.

The firms participating included the following:

E. Allman and Co. Ltd., Micron Sprayers Ltd., Cooper, Pegler and Co. Ltd., W. J. Craven and Co. Ltd., The Dorman Sprayer Co. Ltd., Eclipse Spraying Co. Ltd., Drake and Fletcher Ltd., Evers and Wall Ltd., Four Oaks Spraying Machine

(*Top*) **Mr. E. Bals demonstrates the 'Mini-Micron'** (*Centre*) **This 'Tornado Jet Junior' was also exhibited** (*Bottom*) **The 'Autoblast 5' at work**



Among the spraying machines demonstrated at Fernhurst were (*left*) the Watson' 200 ' trailer sprayer and (*right*) the ' Spraycrop 25 '

Co. Ltd., W. T. French and Son Ltd., Kent Engineering and Foundry Ltd., Welding Industries Ltd., Ransomes, Sims and Jefferies Ltd., Romac Industries Ltd., Swingfire Ltd., L. H. Watson Ltd., W. Weeks and Son Ltd., Barclay, Ross and Hutchison Ltd., J. R. Keys, Nursery Trades (Lea Valley) Ltd., E. J. Woollard Ltd., Thomas Robinson and Son Ltd., Finch and Knight Ltd., E. R. and F. Turner Ltd., A. K. Tattersall and Son Ltd., and Farmfitters Ltd.

The exhibits included a wide range of low-volume sprayers, both of the tractor-mounted type and of the towed type, the machinery of which was either operated from the power take-off of the tractor or in some of the towed models by means of a separate engine. It was remarkable to see the manner in which types of boom and attachments have been diversified of late years, many machines today being capable of being adjusted to give horizontal sprays for use with row crops in the field or vertical or angled sprays for use in orchard or bush crops.

Considerable interest attached to the exhibits which showed the manner in which the autoblast machine, first referred to in WORLD CROPS in 1949, has evolved of late years. We need hardly mention that this type of machine depends on a spray from circularly arranged jets being further atomised and distributed by a high-speed blast of air provided by a specially designed fan situated just behind the plane of the spray jets. Three types of models of this machine were exhibited designed for use under varying conditions. Interest for users in tropical countries centred in the displays of portable power sprayers and dusters. These included the ' Mini Micron ' sprayer, the ' Spartan ' sprayer and the ' Swingfog ' fog blower among a number of others.

Among special exhibits displayed on the ground was one on the new ' Mergamma D ' seed dressing made by Plant Protection Ltd. for protection against cereal root diseases and wireworm. This dressing is applied at only 1 oz. per bushel. There were also displays of protective clothing for use when toxic compounds are being applied to crops.

The demonstration must on all counts be ranked as an outstandingly successful achievement.

A New Cotton Planter

This machine was designed originally to handle the poor sample of undelinted cotton seed used in Turkey, but the collapse of that market caused the company to seek another outlet. However, valuable information was obtained from the Turks as to the machine's behaviour and as a result important modifications were incorporated which resulted in not only an increase of efficiency and greater simplicity but a marked reduction in price. The machine consists in fact of units which can be attached to any toolbar. In the case of the Ferguson where there are no depth wheels depth is maintained by triangulating the lozenge which is made up by the link arms, the link attachment of the toolbar and the back of the tractor. This triangulation is carried out by means of a check chain which can be adjusted to lift or lower the front of the planter. Greater variations in overall depth can be effected by adjusting the position of the rear wheel bearings, which adjustment also compensates for coulter wear.

Points which, it is claimed, make the machine superior to others are: The patented sowing mechanism which is virtually unblockable, the short large section seed tube, the easy-running coulter which while cutting the soil cleanly does not displace it unduly and the coverers which can be adjusted to deflect soil from the coulter under the press wheel, thus leaving a slight ridge. The press wheel is of ample diameter, thus preventing its taking the soil forward and uncovering the seed.

It is stated that the machine is particularly free running and that although drive is from the press wheel there is never any question of wheel slip. The seed-rate is varied over an extremely wide range of 11 gear wheels which require only one nut to be loosened in order that they may be changed. Attachment to toolbars is simple and consists usually of two brackets and tab involving four bolts and row width is from a minimum of 40 cm. upwards.

The new cotton planter produced by Keith Associates Ltd.

WORLD CROP REPORTS

WORLD

Almond production. The 1954 almond production in the leading foreign producing countries will be 14% lower than last year, based on preliminary crop indications. A total production of 72,500 short tons, shelled, has been forecast for these countries, compared with 84,000 tons estimated for 1953 and the five-year (1946-50) average of 73,100 tons. Sharp decreases are indicated for the two largest producing countries, France and Spain. Decreases are also expected in Portugal and French Morocco. Increased production is indicated only in Iran.

The poorer prospects for Italy are attributable to bad weather in the Bari district (Puglia region), which normally produces more than half of the Italian crop. Rain, hail, snow, frost and high winds there during the flowering season had an adverse effect on the set of nuts from the regular bloom. The ultimate size of the Puglia crop is still uncertain, depending upon the set resulting from the off-bloom following the frost. The Sicilian crop is expected to be nearly as large as in 1953. Earlier prospects for a big crop in Sicily were dashed by unstable late winter weather, but the outlook is reported as still generally good.

Although considerable uncertainty exists in Spain concerning prospects for the 1954 almond crop, it appears probable that the harvest will be considerably smaller than the 1953 production of 27,800 short tons, shelled. There is little doubt that substantial damage resulted in various growing areas from the extremely cold weather which prevailed over Spain during the first week of last February. However, there are wide differences in the estimates of the extent to which losses of the regular bloom have been offset by the later off-bloom. It is still too early to fully evaluate the crop resulting from such bloom. Past experience has shown that the off-bloom, if it does not shed, will often result in a high proportion of poor quality nuts. The frost damage in both Italy and Spain, while affecting the bloom, did not extend to the trees. Crops following this year's are, therefore, not expected to be affected as a result of the freeze this spring.

Indications are that Portugal will have a large crop for the third year in succession even if lower than last year's very large crop. The forecast decrease is attributed to cold damage in February in the Douro area, where production has been increasing because of new planting. A bumper crop has been forecast for Iran following exceptionally favourable growing conditions this spring.

Foreign stocks, estimated at approximately 6,000 short tons, in early June 1954 are much below the level of the previous two seasons at this time of the year in the five exporting countries, *i.e.* exclusive of France. In June 1953 they were estimated at 13,900 tons and in June 1952 at 12,100 tons. Only Italy, with about 4,500 tons, and Portugal, with 700 tons, have any appreciable stocks, but even in these two countries the stock level is less than half of what it was a year ago. In both of these countries, too, it is expected that there will be little, if any, old-crop almonds on hand at the start of the new season.

Exports of these five countries so far this season are estimated at 64,000 short tons, shelled basis, representing a much faster movement than in the same period last year, when only 42,400 tons were moved. Last year, however, substantial additional tonnages continued to move the rest of the season, so that exports for the entire 1952-53 season totalled 63,665 short tons. With only a few thousand tons still available for shipment this season, 1953-54 exports by these countries should not exceed those in 1952-53 by more than 10%.

Foreign Crops and Markets

UNITED KINGDOM

Agricultural census. The provisional results of the June 4, 1954 agricultural census show a decrease of 378,000 acres in the total area of tillage (crops and bare fallow) as compared with a year earlier. The area of bare fallow increased by 51,000 acres, so that the decrease in crop area was 429,000 acres. About half the decrease of tillage is reflected in an increase in temporary grass, and the other half in an increase in permanent grass.

The area of wheat increased 224,000 acres, but other cereal crops showed appreciable decline: barley 162,000 acres, oats 184,000 acres and mixed corn 197,000 acres.

INDIA

Barley prospects. The Directorate of Economics and Statistics of the Indian Ministry of Food and Agriculture has issued final all-Indian estimates of barley acreage and output for 1953-54. Acreage is estimated at 8,190,000 acres and output at 2,721,000 tons, as against 8,010,000 acres and 2,849,000 tons in the partially revised estimate for 1952-53.

The increase in acreage has been shared mainly by Uttar Pradesh, the Punjab, West Bengal, PEPSU and Bombay and has been attributed to adequate water supply at the time of sowing. This increase in acreage has, however, been offset to a considerable extent by the decreases reported in Bihar, Rajasthan, Madhya Bharat and Jammu and Kashmir due to unfavourable weather conditions at the time of sowing.

In spite of an overall increase in acreage, the estimate of production is lower than last year. The decrease has occurred mainly in Rajasthan, Uttar Pradesh, Bihar and Madhya Bharat, due partly to the decrease in acreage and partly to unfavourable climatic conditions during the growing period. In Uttar Pradesh, the crop was damaged by hailstorm and heavy showers. In parts of Rajasthan and Vindhya Pradesh, too, the crop was damaged to some extent by hailstorms, cold waves and a lack of rain. The Punjab, PEPSU, West Bengal, Jammu and Kashmir and Bombay have, however, reported increases in the current year's production due to favourable climatic conditions during the growing period.

RUSSIA

Agricultural report. Spring sowing was carried out successfully by the collective farms, machine and tractor stations and State farms. The plan for spring grain sowing was overfulfilled.

The area sown with spring crops by the collective farms and State farms in 1954 was 9,500,000 hectares bigger than last year. Moreover, the area cultivated with spring grain increased by 6,400,000 hectares, including an additional 3,600,000 hectares to the area sown with spring wheat, and an additional 756,000 hectares to the area sown with maize. An area of 354,000 hectares was added to the cotton plantations. The areas under sugar beet, sunflower seed and other oil crops, annual grasses, fodder roots and silage crops are also greater than last year. Larger areas than last year were planted with potatoes and vegetables, and yet the planned provisions for potato and vegetable planting were not carried out in full. Long-staple flax planting also fell short of the planned target.

An area of 13 million hectares of virgin and fallow land is to be reclaimed for agriculture in 1954-55 by the collective farms and State farms in Kazakhstan, Siberia, the Urals, the Volga area and the North Caucasus. About 10 million hectares had already been ploughed up by July 10, 1954 for this year's and next year's harvests. In

accordance with the State plan provisions, the collective farms and State farms were to sow 2,300,000 hectares of virgin and fallow land with grain in the spring of 1954; the actual area sown is 3,600,000 hectares.

Soviet News

CANADA

Crop prospects. Weather and scattered showers continued throughout the west at the beginning of August. As a result crops were advancing rapidly in most sections, according to the crop report of the Canadian National Railways.

Northern Manitoba. Some points showed up to 85% of wheat in head, with others as low as 10% to 20% headed. Generally, however, crops showed improvement and leaf rust infection was light and scattered.

Southern Saskatchewan. Light to heavy rust was evident and warm, dry weather was required as a deterrent to potential damage in this respect. While crops were two weeks late, wheat was 80% to 90% headed.

Central Saskatchewan. Crops were 75% in head. Rust created a threat from Saskatoon west and north to Battleford. Fall rye prospects were average or better in most areas.

Northern Saskatchewan. Winds had flattened crops in some districts, but generally good yields were in prospect for this territory.

Central Alberta. Local hail damage was reported from several districts. Wheat was from 45% to 80% in head, with heads being shorter than usual in some areas. Summer fallowing and haying were still in progress.

Peace River District. At some points wheat was commencing to ripen. An excellent hay crop had been harvested and fallowing was in progress.

HOLLAND

Sugar beet. *C. Czarnikow's Review* No. 162 contained a report on sugar beet in Holland at the beginning of August. Judging from appearances, the growth of beets was not favourable. Damage from black aphides and other pests was noticeable here and there, whilst there were many gappy fields. Growth of the leaves, however, was on the average good, but root weight and sugar content were very backward compared with former years. Development, therefore, was expected entirely to depend on weather conditions during this and next month. The favourable leaf development would still allow of good weights and reasonable sugar content given sufficient sunny days and seasonable temperatures. It was very difficult to form any reliable estimate of the crop, but, based on the assumption that part of the arrears will be made up, the forecast was that the 78,550 hectares sown should give a root production of 3,100,000 tons and a sugar output of 440,000 tons, raw value. Whilst this root tonnage was below the previous estimate, the sugar estimate was 10,000 tons higher than its predecessor.

UNITED STATES

Oats. The 1954 oats crop is forecast at 1,545 million bushels—the largest on record. This is 27% larger than last year's production and 17% above average. With the largest harvested acreage in eight years and above average yields in all but five States, production is larger than last year and above average in all regions of the country. The U.S. yield of 36.8 bushels per acre is 5.9 bushels above last year, 3.5 bushels above average and is exceeded by only the yields of 36.9 bushels in 1948 and 37 bushels in 1915.

In the south, where the bulk of the oats are fall-sown, harvesting was about completed by July 1. Much of the oats in the South Atlantic area was seeded late in dry seedbeds last fall. Subsequent dry weather retarded germination and stands were uneven. However, with adequate moisture during late winter and spring months the crop made good growth. Extremely high temperatures and shortages of moisture reduced yield and lowered quality in some areas. From the Carolinas to Louisiana conditions during harvest were almost ideal and yields were good to excellent, though a little below last year's record or near record. Mississippi and Arkansas reported exceptionally good yields for the third consecutive year. Texas oat yields were sharply curtailed by droughty conditions in February and March and by spring frosts. Some acreage which headed very short in South Central Texas were cut ripe and baled.

Growing conditions have been generally favourable in all major oats States, and the hot weather has been the main detrimental factor thus far this season. By July 1 harvesting had progressed under favourable conditions northward into the leading oats-producing North Central States. Ripening was hastened by high temperatures during the second half of June over a large part of this area, but because of the wide variation in development resulting from a prolonged seeding season only a part of the acreage was seriously damaged. Good yields were harvested on the small acreage of fall-seeded oats in the southern portions of Missouri, Illinois and Indiana, and from early spring seedings. In the Dakotas and Minnesota and other late harvesting States most of the crop had a healthy colour and good growth. In Wisconsin some fields were yellowing from too much wet weather. The prospective yield of 38.2 bushels per acre in the North Central States is about one-fourth larger than last year.

In the west prospective yields of irrigated oats are excellent, except in Colorado, Wyoming and Utah, where prospects were lowered by water shortages. Oats on non-irrigated land had adequate moisture for normal development through June, except in Colorado, Wyoming, New Mexico and portions of several other States.

The acreage planted to oats for all purposes in the fall of 1953 and spring of 1954 was the largest on record. Total seedings are estimated at 46,565,000 acres, about 6% more than either 1953 or the 10-year average. This is the third consecutive year of increased seedings. The chief reasons for the current increase are the diversion to oats of part of the acreages formerly in crops now under acreage allotments, the need for oats for winter pasture, hay and silage, and an attempt to replenish stocks of good quality oats for feeding purposes.

Plantings were increased most in the South Central States, by 23%, or nearly 1 million acres above last year. The largest acreage gains in this area were in Texas, Oklahoma, Mississippi and Arkansas. In the 12 North Central States, which as a group produce about four-fifths of the nation's oats for grain, seedings were increased in all States except Wisconsin and Kansas, where slight reductions were made, and in Minnesota, where there was no change. The net increase for the group was 904,000 acres. In Wisconsin, as well as in northern portions of other Lake States, progress of planting was interrupted by frequent rains and caused many farmers to shift to maize and other crops. A larger acreage than in 1953 was also reported for other geographic areas. Seedings were increased 11% in the Western States, 9% in the South Atlantic and 8% in the North Atlantic States. About 4.6 million acres or 9.8% of the total U.S. seedings will not be harvested for grain and have been or will be diverted for such other purposes as hay, silage, pasture, ploughed under, or abandoned.

The acreage for harvest as grain is estimated at 41,980,000 acres, the largest in eight years. This is 2.6 million acres more than last year and 2.5 million acres above average. Nearly one-half of the increase in harvested acreage is in the higher yielding North Central States, and another third is in the South Central States.

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